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Remedial Investigation Report for the Eastern Michaud Flats Site

Part III
Air Quality Characterization
Air Modeling Report

Volume II
Sections 1 – 6

Prepared for
FMC Corporation
J.R. Simplot Company

Bechtel Environmental, Inc.

September 1995

2.14

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Introduction

This document supplements the characterization of ambient air quality presented in Volume 1 of Part III of the RI report. It presents emission inventories for sources within the FMC and J. R. Simplot Company facilities as well as the Bannock Paving Company (BAPCO) plant. These inventories were used with EPA-specified atmospheric dispersion modeling codes and site-specific meteorological data to characterize the fate and transport mechanisms of source emissions within the EMF study area.

This document is both a revision and expansion of a previous study titled "Characterization of Ambient Air Quality in the EMF Study Area" (Bechtel, 1994k). Source characterization data not available during preparation of the previous study, as well as revised operation data for several emission sources and improved model input parameters were used in carrying out this revision. It also presents a slightly different period of modeling prediction—October 1, 1993 through September 30, 1994. The previous study evaluated the period between July 1, 1993 through June 30, 1994. Air monitoring data for the months of July through September, 1994 were not available during preparation of the earlier study. These data have been included with the monitoring data collected between October 1993 through September 1994, so that an evaluation of model performance—through comparison of model predictions with monitoring data—can be made for a one-year period. Air quality monitoring data were not available before October 1993.

The EMF site, approximately 2.5 miles northwest of Pocatello, Idaho, includes approximately 2,600 acres in Power and Bannock counties. Within the EMF site are two ore processing facilities: FMC Corporation and J.R. Simplot Company. Bannock Paving Company is located west of FMC's main facility on FMC's property. All three were active, operating facilities during the period of investigation. However, operations at Bannock Paving were discontinued in March 1995. Emissions from a number of sources at FMC will be reduced during 1995 and 1996 through additional emission controls and process modifications.

1.1 PURPOSE OF THIS REPORT

Atmospheric dispersion modeling provides site-specific characterization information that monitoring data alone cannot provide. Modeling techniques permit estimation of constituent concentrations in ambient air over a wide area and on all days within the study period. Consequently, modeled estimates of constituent concentrations can be made for areas where monitoring stations were not placed.

Because monitoring data are collected on predetermined dates, it may not be possible to obtain monitoring results during all of the meteorological conditions that might occur within the study area. Modeling techniques allow ambient concentrations to be calculated over all of the meteorological conditions that were recorded using continuous meteorological monitoring equipment. Modeling also allows contributions from individual sources to be evaluated, unlike ambient monitoring, which records the collective impact of all sources within a study area.

Modeling analysis can be constrained by the data available to characterize source emissions and the potential uncertainty associated with emission-rate calculations. Also, modeling analysis can be difficult to apply in complex, elevated terrain. Monitoring data provide "ground truth" against which modeled estimates of constituent concentrations can be evaluated. By combining modeling and monitoring techniques, the strength of each method can be employed while the limitations of each can be compensated by the other technique.

Both this characterization of ambient air quality and the previous study, (Bechtel 1994k), were developed using atmospheric dispersion modeling techniques, emission source sampling, and data obtained from an ambient air monitoring program. A previous study of air quality characterization for the EMF study area (Bechtel, 1993a) was based largely on modeling techniques that used estimates of source emissions. Updated versions of the same EPA dispersion modeling codes employed in the 1993 study have been used in the 1994 and 1995 reports. New information has been obtained on source emission profiles for 20 major sources within the EMF facilities. The emission inventory was also expanded to include the principle

radionuclides of the uranium-238 and thorium-232 decay series. As reported in this document, these data have been used in conjunction with emission profiles for approximately 100 other sources in an atmospheric dispersion model of EMF facility emissions.

This atmospheric dispersion modeling analysis only addresses the contributions of air emissions from BAPCO, FMC, and Simplot. Other emission sources not addressed in this study, which contribute to the overall air quality in the Pocatello area, include:

- Smoke from wood burning stoves
- Agricultural fugitive dust
- Vehicle emissions
- Open gravel pits
- Other industrial facilities
- Railroads
- Offsite road dust
- Construction activities
- City of Pocatello sewage treatment plant process emissions and sludge spreading activities north of the EMF facilities

The modeled levels of constituent concentrations are compared with background air quality. Background air quality was determined through statistical analysis of constituent levels detected in samples collected at a distant (12 miles) air quality monitoring site (Site 6). Only those samples collected when this site was upwind from the EMF facilities have been used to characterize background for the purposes of evaluating model performance.

The EMF ambient air quality monitoring program was initiated in October 1, 1993 at a seven-site monitoring network (Figure 1.1-1), following guidelines developed with EPA Region 10 input (Bechtel, 1993a and b). The scope and results of the monitoring program are presented in Part III, Volume 1 of the RI Report.

Ambient air quality was characterized by analyzing 24-hour exposure duration particulate filters on collected PM_{10} and TSP size-fractions. These filters were analyzed for particulate mass (PM_{10} and TSP), fourteen metals (aluminum, arsenic, barium, beryllium, cadmium, chromium (total), manganese, nickel, total phosphorus, selenium, silver, thallium, vanadium, and zinc), and nine radionuclides (lead-210, polonium-210, radium-226 and -228, thorium-230 and -232, and uranium-234, -235, and -238). Particulate filters collected between October 1993 through March 1994 were analyzed for most of these constituents, whereas the majority of the filters collected from April through September 1994 were analyzed only for particulate mass. Particulate and gaseous fluorides and crystalline forms of silica were also measured between October 1993 through April 1994.

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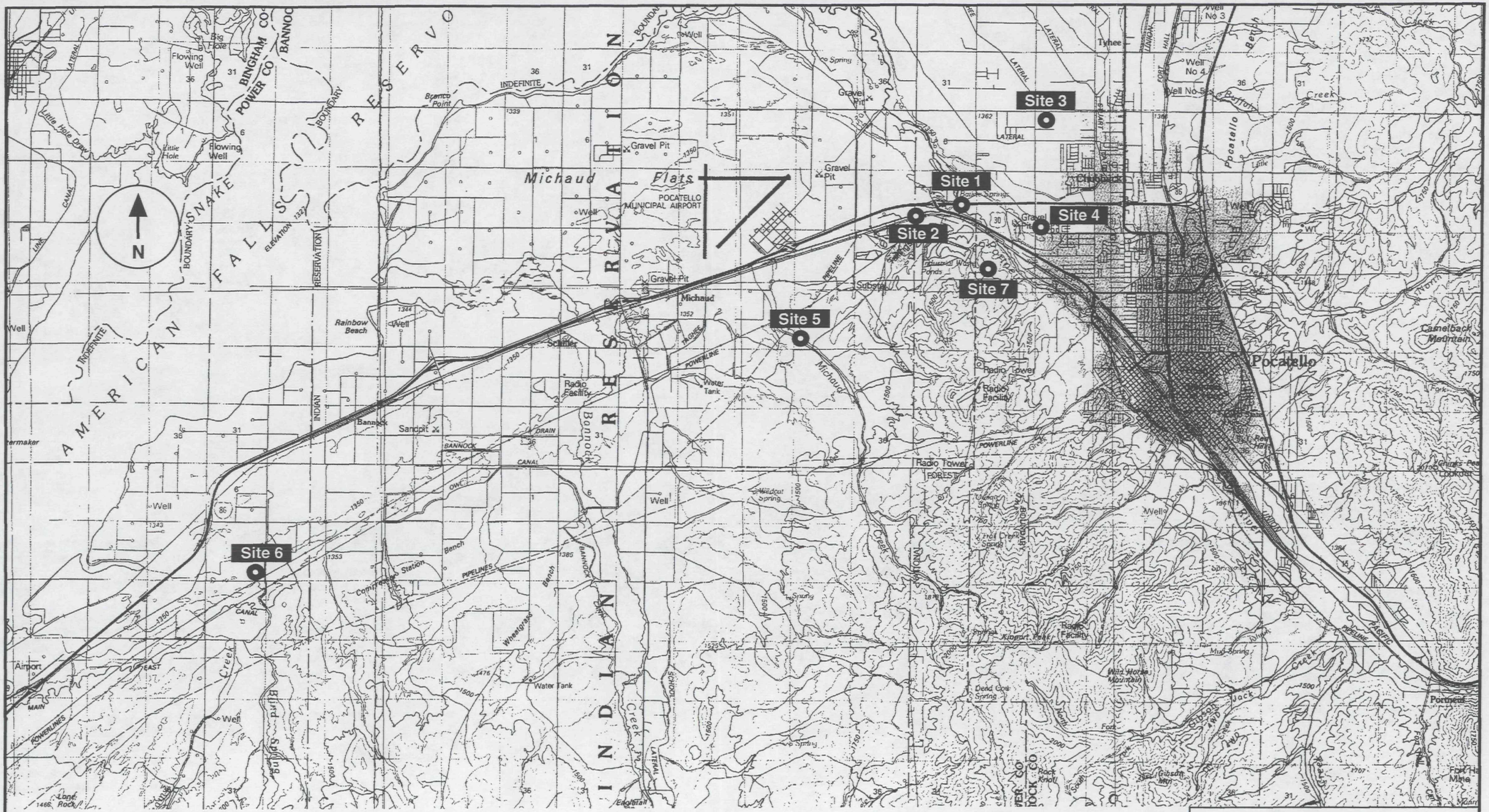

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO	
EASTERN MICHAUD FLATS POCATELLO, IDAHO	
EMF Air Monitoring Sites	
JOB No. 21372	DRAWING NO. FIGURE 1.1-1
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1.2 REPORT ORGANIZATION AND RELATED REPORTS

Due to the scope and complexity of the EMF air pathways investigation, this modeling analysis and a full report on the EMF ambient air monitoring program have been grouped as Part III of the overall RI Report.

Part I of the RI Report is an executive summary of the overall remedial investigation. Part II presents information specific to the investigation of groundwater, soils, surface water, and surface water body sediments, as well as a summary of air monitoring data.

Part III of the RI Report has two components:

Volume 1 — a description of the scope and results of the ambient air quality monitoring program, plus site-specific meteorological measurements collected over the course of the monitoring period.

Volume 2 — this report. Section 2 contains a brief description of the industrial facilities located on the EMF site. Section 3 provides a detailed discussion of the emission inventories used in the modeling and the revisions made in these inventories since the publication of previous reports. The modeling approach is presented in Section 4. Modeling results and an assessment of model performance are provided in Section 5. Section 6 contains a discussion and summary of the modeling results.

Supporting materials are included as appendices. The revised emission inventories are presented in Appendix AE, and the equations used to calculate emission rates are provided in Appendix AF. The meteorological data used in the study are presented in Appendix AC. Appendix AH presents typical output from the model and Appendix AI presents a detailed review of model performance.

1.3 OVERVIEW OF POCATELLO REGION

The local terrain in the Pocatello area is classified as complex for atmospheric dispersion modeling purposes. As shown in Figure 1.1-1, from the southwest clockwise through north-northeast of the Simplot facility, the terrain is generally flat for several miles. East of Pocatello, the Pocatello Mountain Range rises from about 4,400 feet to about 6,500 feet above mean sea level. Southeast of the FMC and Simplot facilities is the city of Pocatello, located in the funnel-shaped Portneuf Valley. The valley virtually closes at the southern end of Pocatello.

The north end of the Bannock Range is just south of the two facilities. This range tapers to a north-pointing wedge east of the Simplot site and forms one side of the Simplot gypsum stacks. The ridge just southeast of Simplot rises from Simplot's base elevation of 4,449 feet to approximately 5,700 feet. To the southwest, the Bannock Range gives way to the Michaud Flats of the Snake River drainage to the north and to the Arbon Valley on the west.

Part II of the EMF Remedial Investigation Report contains a full description of the geography, environmental setting, demographics, and land use patterns within the EMF study area.

Process Descriptions

This section briefly describes the FMC and Simplot facility processes. Greater detail on these processes and a discussion of byproduct and waste management are found in Part II of the EMF RI report. A brief description of the BAPCO facility processes is also presented.

2.1 FMC PROCESS OVERVIEW

The FMC Corporation Elemental Phosphorus Plant is located approximately three miles northwest of Pocatello, Idaho, and approximately one mile southwest of the Portneuf River, a tributary of the Snake River. FMC has been in operation at this location since 1949 (Figure 2.1-1).

FMC's commercial product is elemental phosphorus (P_4), as shown in the general process flow diagram Figure 2.1-2. This figure includes annotations which link the process units with the emission sources described in Section 3 of this report. Ore is transported to the facility via rail car. Since ore is not shipped during the winter months, it is stockpiled onsite during summer months to ensure a steady supply for the winter. The ore is stockpiled in two long piles, from which it is reclaimed for processing. It is screened, crushed, and transferred to the briquetting process building, with ore-handling emissions controlled by baghouses, latex sprays, and/or covered conveyor belts.

The briquetting process presses ore into "green" briquettes. These are heated in a calciner to 1,200 to 1,300°C to drive off moisture, remove organic matter, harden the briquettes, and convert them into nodules that will withstand further processing. The calcining process produces an off-gas stream containing particulates and naturally-occurring radionuclides, which are removed by a series of primary and secondary wet scrubbers located in the calcining area. Calcined nodules are cooled. Some nodules are stockpiled, while most continue to the proportioning building where they are stored along with coke and silica. Nodules are blended with predetermined amounts of coke and silica before being fed into an electric arc furnace.

The furnace building houses the central processing step for the production of elemental phosphorus. It contains four electric arc furnaces. A mixture of calcined ore nodules, coke, and silica are charged into each furnace, which is equipped with three graphite electrodes, and which

operates at a reducing atmosphere, with temperatures ranging from 4,170°F (2,300°C) to 4,890°F (2,700°C).

In the furnace, phosphate in the ore is reduced to elemental phosphorus vapor. This reduction process generates one main product and three byproducts:

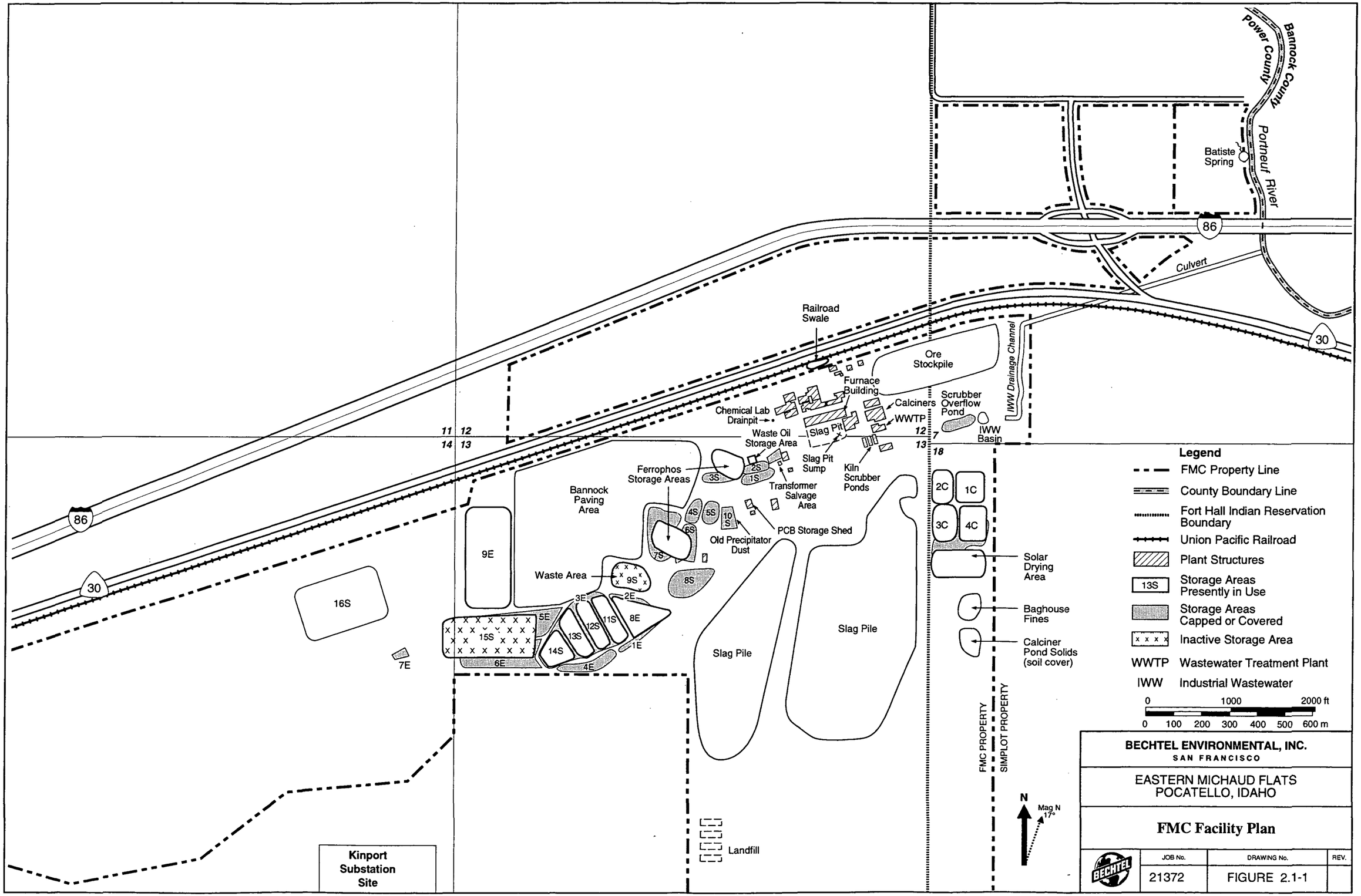
- The main product (elemental phosphorus vapor) becomes liquid in water spray condensers. The liquid phosphorus is collected in sumps and pumped to the product storage area (phos dock) and onto rail cars for shipment, or into tanks for interim storage. The phos dock is equipped with a scrubber to control fume emissions.
- The solid byproducts are slag and ferrophos. Slag (composed primarily of calcium silicate minerals) is tapped, cooled, and stockpiled. Ferrophos (predominantly an iron phosphorus alloy) is tapped, cooled in molds, and sold as a commercial product. The tapping process is performed in a hood-type arrangement to collect fumes generated during the tapping process. These fumes then pass through a series of wet primary and secondary scrubbers.
- The gaseous byproduct from the furnace is primarily carbon monoxide (CO) with some entrained dust, which is removed using electrostatic precipitators. Carbon monoxide is used for calciner fuel; excess CO is flared.

Water application, street sweepers, and magnesium chloride spray treatments control emissions from paved and unpaved roads.

FMC plans to implement a number of changes in process operations and emission control strategies during 1995 and 1996. These include enclosing the coke railcar unloading facility and upgrading material handling systems used to recycle fines from the calcining process and baghouses.

Air emissions from the FMC facility are regulated by the state of Idaho in Air Permit 1260-0005. The FMC facility permit covers emissions from ore handling/crushing operations, calciners, various material handling systems, four electric arc furnaces, electrostatic precipitators, carbon monoxide flaring system, and the phos dock.

Air Modeling Report
Figures for Section 2.1



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FMC Facility Plan

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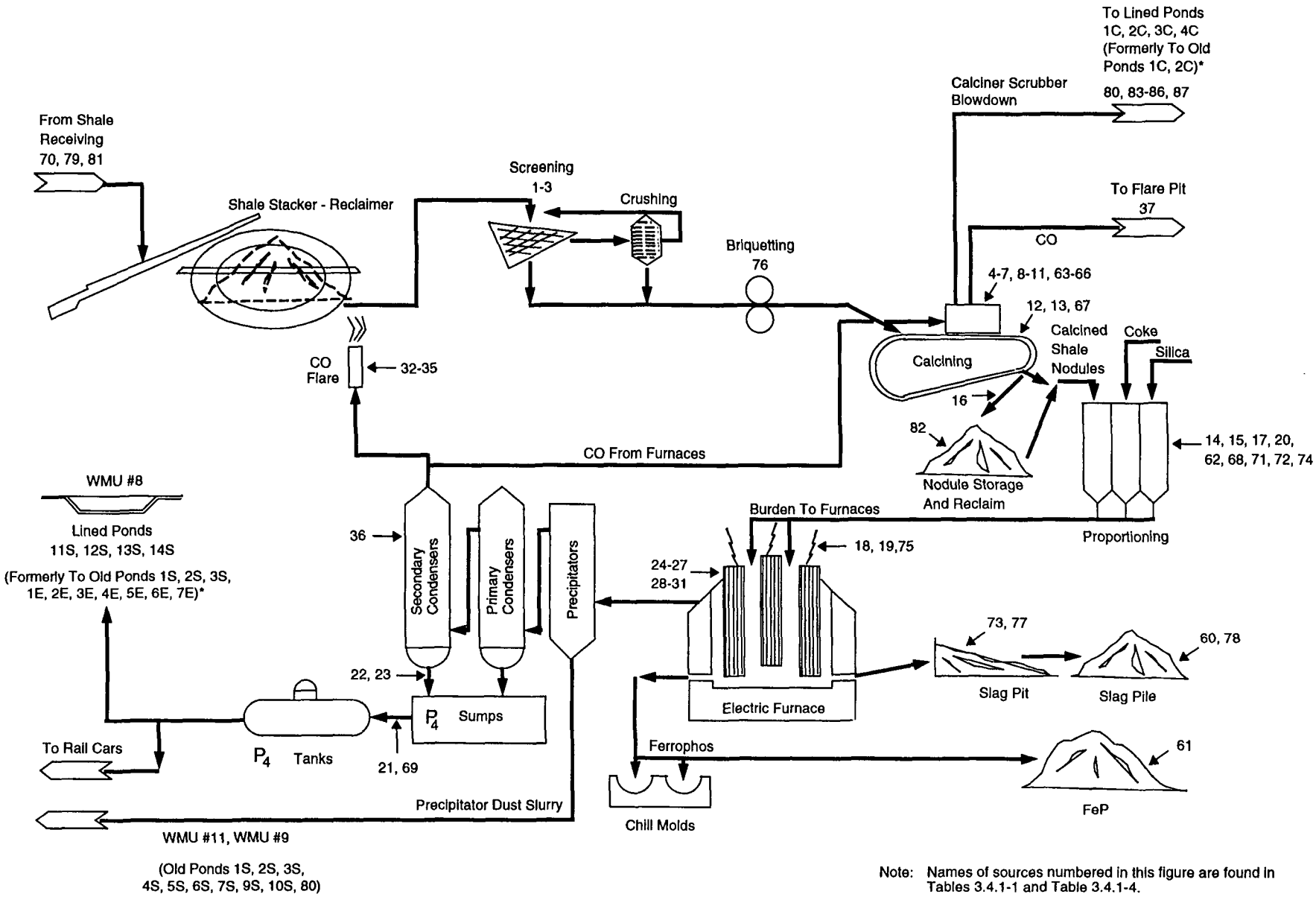

Note: Names of sources numbered in this figure are found in Tables 3.4.1-1 and Table 3.4.1-4.

* Designation of "Old Pond" means it has been closed and is no longer operational.

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Figure 2.1-2 FMC General Flow Diagram

2.2 J.R. SIMPLOT PROCESS OVERVIEW

The J.R. Simplot Company Don Plant, located adjacent to the FMC facility, began production of superphosphate fertilizer in 1944. Phosphoric acid production began in 1954. The site covers approximately 1,130 acres, adjacent to the eastern property boundary of the FMC plant (Figure 2.2-1). The plant manufactures 12 principal products, including five grades of solid fertilizer and three of liquid fertilizers. The plant is a complex of several different interrelated processing units, each producing intermediate or final products. The overall process flow diagram is shown in Figure 2.2-2. This figure includes annotations that link the process units with the emission sources described in Section 3 of this report.

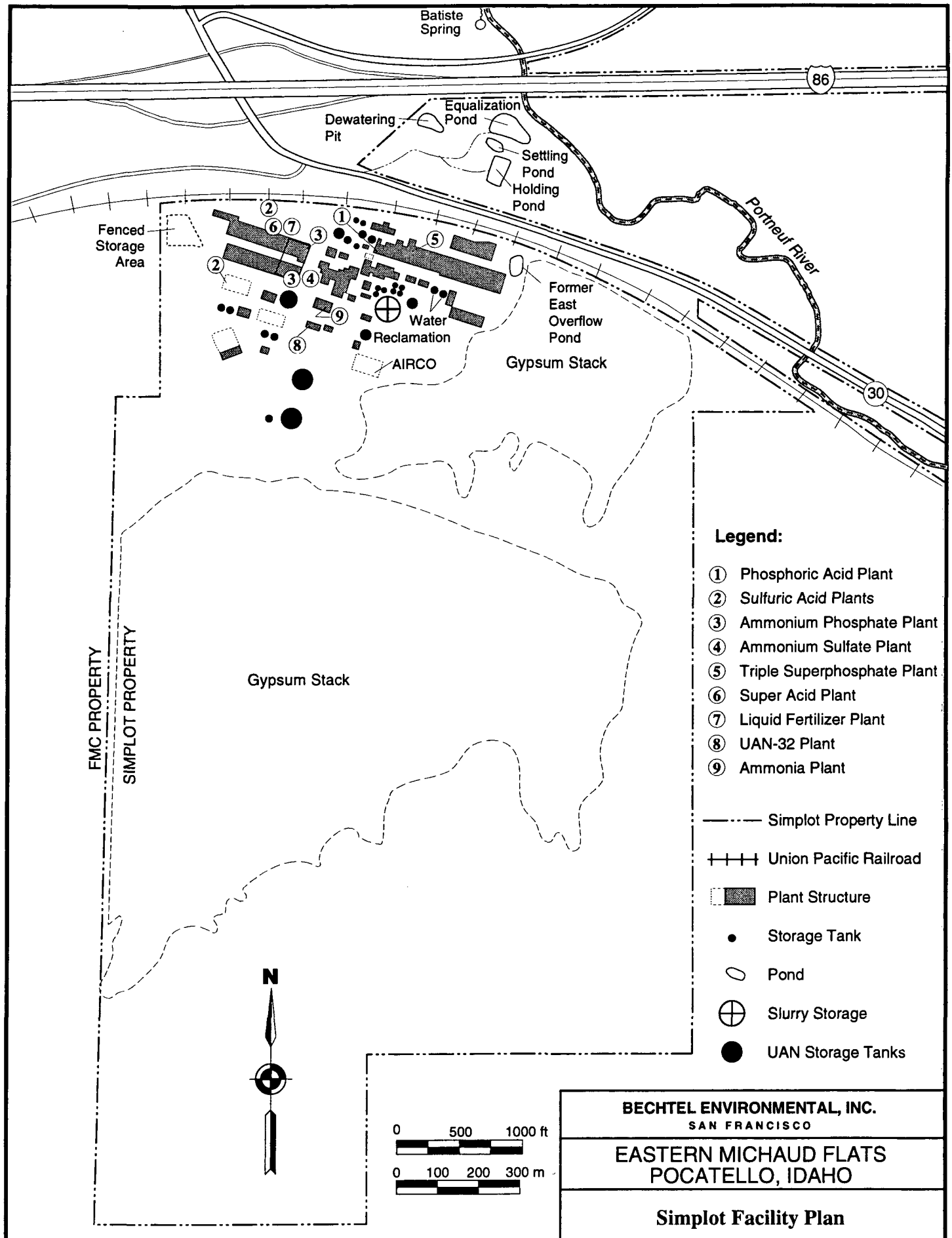
Prior to September 1991, ore was formerly transported from the Gay, Conda, and Smoky Canyon mines to the plant via rail car. In September 1991, the Simplot plant began receiving ore solely from the Smoky Canyon mine through a slurry pipeline. Upon arrival at the plant, ore slurry is thickened to approximately a 70 percent-solids content before being stored in agitation tanks, then pumped to the phosphoric acid digester. The slurry is mixed with sulfuric acid to produce phosphoric acid and gypsum. Gypsum is pumped as a slurry to the gypsum stack for storage. Some of the phosphoric acid is used to make fertilizers, while most are concentrated into stronger acids.

Sulfuric acid used in the manufacture of phosphoric acid is produced in two separate plants. Sulfur is shipped to the facility via rail car and converted to sulfuric acid by burning the liquid sulfur with air.

The facility makes five main grades of solid fertilizers: mono-ammonium phosphate sulfate, di-ammonium phosphate, mono-ammonium phosphate, ammonium sulfate, and triple superphosphate, as well as three liquid fertilizers: normal shipping acid, super acid, and UAN-32, a solution of ammonium nitrate and urea.

Emissions from the process stacks are controlled by several types of scrubbers and/or baghouses. All onsite roads are paved and a vacuum truck is used to reduce road emissions.

Air emissions from the Simplot facility are regulated by the state of Idaho in Air Permit 1260-0060. The permit covers emissions from ore handling activities, individual process plants, and reclaim cooling towers. The introduction of the wet slurry system in 1991 for ore transportation has eliminated fugitive dust emissions from open-ore storage and handling. The calciner units were taken out of service in 1990.



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Simplot Facility Plan

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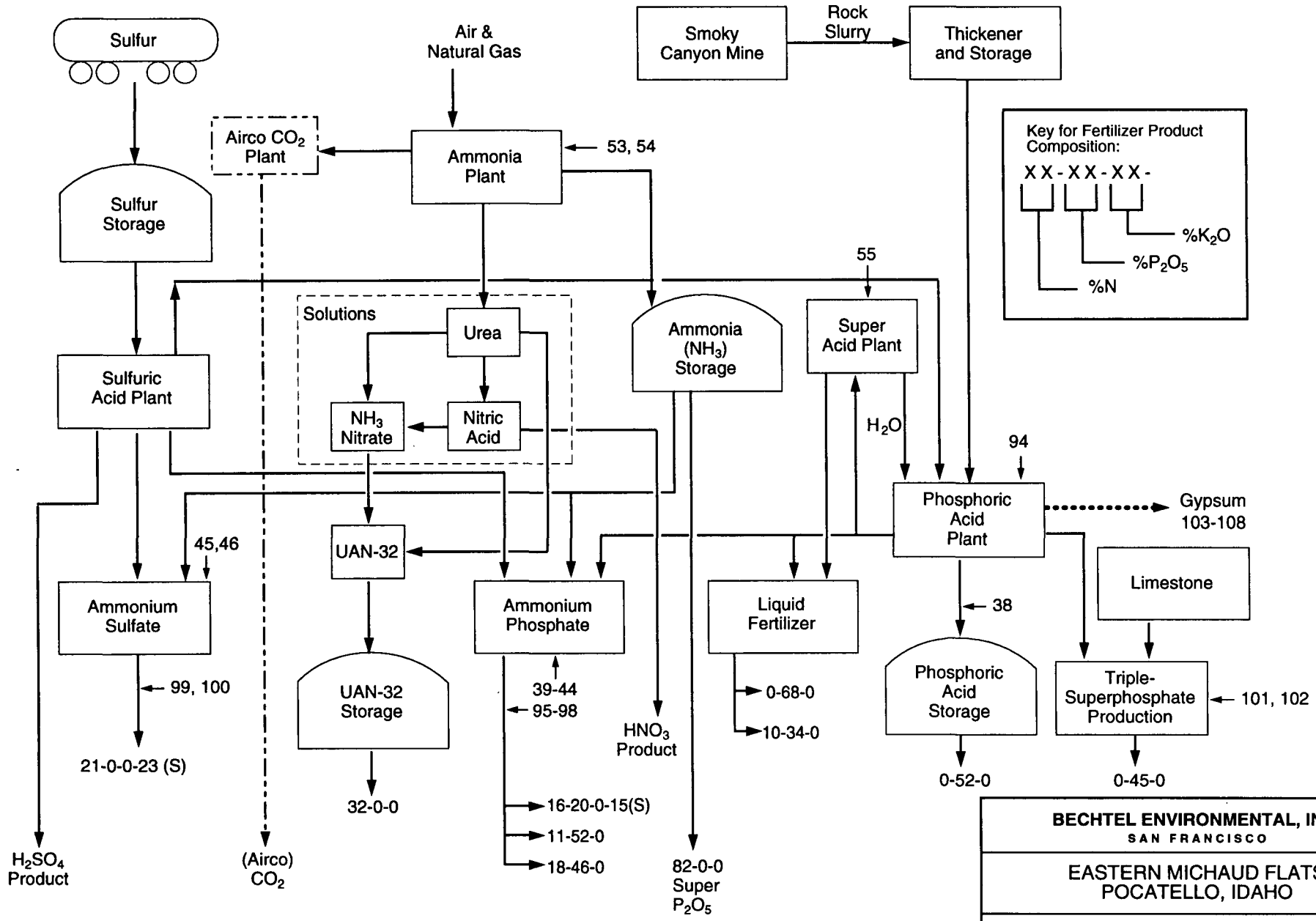

Note: Names of sources numbered in this figure are found in Table 3.4.1-2 and Table 3.4.1-5.

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General Flow Diagram – Simplot Don Plant Flow Sheet

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2.3 BANNOCK PAVING PROCESS OVERVIEW

During the period of investigation, BAPCO operated a commercial paving and aggregate-handling company on land leased from FMC in the north central portion of the FMC property, west of FMC's main facility (Figure 2.1-1). BAPCO periodically crushed slag and ferrophos, and dried coke for FMC. It also periodically crushed slag for its own use and processed asphalt at this facility. In addition to process equipment used for these activities, the BAPCO facility contained storage piles of slag, asphalt, and coke.

BAPCO's operations at the FMC site were discontinued in March 1995. The company has relocated its operations to another site in the Pocatello area. It plans to complete necessary site restoration activities on the FMC property by the end of 1995. FMC plans to obtain dried coke from a supplier in another state, and will obtain slag crushing services on an as needed basis from contracted vendors. Section 6 assesses the influence of the closure of the BAPCO facility on future air quality.

BAPCO was not a participant in this investigation, nor is it a party to the Administrative Order on Consent under which this study was conducted (EPA, 1991a). The information reported in this document on BAPCO operations and emissions are based on the 1990 SIP emission inventory published by EPA Region 10. The modifications and expansions to this inventory made by Bechtel are described in Section 3.3.9 of this report. Bechtel did not visit the BAPCO facility nor consult with BAPCO personnel to modify or expand the BAPCO emission inventory. The additional data incorporated into the inventory were not provided by BAPCO.

Emission Inventories and Plant Information

This section describes the development of emission inventories at the FMC, Simplot, and BAPCO facilities. These inventories have been used, along with site-specific meteorological data, as input to the atmospheric dispersion models to characterize potential impacts on ambient air quality attributable to emissions from these facilities. Modeling results are presented in Section 5. The emission inventories are presented in Appendix AE.

The emission inventories presented in this section were derived from inventories developed for the EPA in 1991 by OMNI, Inc. for use in the State Implementation Plan (SIP) for the Pocatello area (OMNI, 1992). The basic information contained in those inventories was provided to OMNI by FMC, Simplot, and BAPCO, although OMNI later modified the inventories. Following the development of the OMNI inventory, the Companies provided substantial comments to the EPA, which led to further revisions by OMNI. These data were used as the starting point for development of the CERCLA emission inventory by Bechtel. In late 1992 (Bechtel, 1993a), the CERCLA inventory was used to identify potential locations for air monitoring sites. The CERCLA inventories reported in the September 1994 modeling study (Bechtel, 1994k) were revisions of those reported to EPA the prior year (Bechtel, 1993a). Previously estimated emission rates for 20 sources were replaced with rates calculated from source-specific sampling. Emission rates for radionuclides were added for all sources, and several sources added to the inventories. Inventory revisions made since the September 1994 report are described in Section 3.1, which also describes other data on source characteristics compiled for the modeling study. These include descriptions of stack operating conditions, unit dimensions, and height of emissions.

The inventories presented in this report are the result of extensive testing and chacterization of emissions at the FMC and Simplot facilities. These inventories are a significant improvement from the information contained in the EPA 1992 SIP inventory—both in the breadth of information presented and in their quality and accuracy. Assumptions and estimates contained in previous studies have been replaced with site-specific emission characterization data.

Calculations and spreadsheet errors identified in the 1992 SIP inventory have also been corrected. As a result, the information developed for this CERCLA investigation is more than sufficient to characterize the impact of facility emissions on ambient air quality.

Organization of Section 3

Section 3.1 clarifies the purpose for developing and revising the inventories and discusses the emissions with respect to typical facility operations. Section 3.2 describes the sources of information used in compiling the emission inventories. Section 3.3 describes the source characterizations during 1993 and 1994. Section 3.4 presents information on physical parameters (e.g., source dimensions and heights of emissions used as input to the dispersion model). A discussion of constituents and emission calculations for FMC, Simplot, and BAPCO are presented in Section 3.5 (PM_{10}, TSP, and fluorides), Section 3.6 (metals), and Section 3.7 (radionuclides).

3.1 RECENT REVISIONS AND PURPOSE OF THE INVENTORIES

Section 3.1.1 describes changes in the emission inventories since the September 1994 modeling study (Bechtel, 1994k). Section 3.1.2 reviews the purpose of the inventories and the role of the daily and average annual emission inventories in the modeling study. Section 3.1.3 describes the constituents included in the inventories.

3.1.1 INVENTORY REVISIONS SINCE SEPTEMBER 1994

The September 1994 CERCLA EMF site emissions inventory formed the basis for the modeling study reported in "Ambient Air Quality Characterization Report for the EMF Study Area" (Bechtel, 1994k). The changes to this inventory since that study generally resulted from:

- Analytical results, not previously available, that were added to characterize emissions for several additional sources and to characterize additional constituents emitted from several sources;
- Different methodologies to calculate emissions requested by EPA;
- Corrections to the inventory spreadsheets; and
- Refinements in emission characterizations for sources identified through case study analyses during model performance evaluation.

The major changes since the September 1994 report include:

1. Particulate emissions for TSP from paved roads were calculated using equation 1 of *AP-42*, Section 11.2.6.3, rather than equation 2. Equation 2 calculates finer particle sizes (i.e., PM_{10}), whereas equation 1 is appropriate for TSP. This resulted in increased TSP emissions from paved roads.
2. Estimated vehicle weights for light, medium, and heavy duty vehicles at FMC were revised (upward) to reflect actual tonnage of each vehicle class used at the facility. Vehicle weights were underestimated in the September 1994 inventory based on erroneous data contained in the 1990 SIP inventory. This change increased particulate emissions from road sources.

3. Total vehicle miles traveled for FMC roads were overestimated in the September 1994 inventory because the total number of trips on each road was applied to each weight class, tripling the count of vehicles traveling on the road. This was an artifact from the 1992 SIP inventory used as the basis for the 1994 inventory. The total number of vehicles was apportioned for each weight class based on 1990 operations at the facility. This resulted in a decrease of paved and unpaved road emissions at FMC.

4. Previous road emission calculations for percent silt were based on 10 μm and 30 μm particle sizes. Percent silt should be based on the weight of the sample passing through a 200 mesh sieve, per *AP-42* (EPA, 1988c). This correction resulted in increased particulate emissions from paved and unpaved roads.

5. Area source emissions of arsenic from the discharge and dust silo baghouses at FMC were inadvertently listed as zero in the metals inventory used in the September 1994 modeling effort. The inventory was revised to reflect estimated arsenic emissions from these two sources.

6. The concentrations of inorganic constituents in coke were added to both the FMC and BAPCO emission inventories for coke handling. In the previous inventory, no inorganic constituent emissions were specified for coke handling, which represent a large source of PM_{10} and TSP. Additionally, corrections were made to uranium emission calculations from coke sources.

7. Total suspended particulate emissions from area sources at Simplot were incorrectly listed as zero in the model input file due to improper linking between the emission inventory and model input file (matrix file). The model input file was revised to reflect the correct emissions from these sources.

8. Fugitive area emissions of inorganics and radionuclides from the FMC furnace building were recalculated to reflect four operating furnaces instead of one, and control efficiencies associated with sources located within a building, rather than uncontrolled sources. This resulted in an overall decrease in fugitive emissions from the furnace building.

9. Area source emissions of metals for the FMC furnace building and proportioning building were recalculated using individual metal fractions for each component of the area source. In the previous inventory, the metal fraction for each component was summed and the total multiplied by the summed PM_{10} emissions for the area. This mathematical error resulted in an overestimation of metals emissions from the grouped area source.

10. The PM_{10} size fractions of several FMC source materials were reanalyzed using XRF Protocol 9, which has lower detection levels than Protocol 3, used in the previous inventory. In addition, beryllium concentrations in these samples were determined using ICAP methods. The source materials were: slag in the slag pile, calciner fines, baghouse fines, shale ore, and ferrophos. This reanalysis detected some constituents that were previously reported as non-detects and resulted in slightly increased emissions of metals for many fugitive dust sources. Beryllium was not been detected in the previous analyses using XRF methods and the instrument detection limit (IDL) was used to calculate emissions from these sources. The reanalysis detected beryllium, but at lower concentrations than the prior IDL. Thus, the calculated emissions of beryllium were reduced.

11. The silt/moisture and metals content for burden material handling and the dust silo baghouse at FMC were recalculated using weighted averages of materials commingled in these sources. The previous inventory did not identify the multiple materials nor recognize that the dust silo baghouse controls dust from a number of different sources.

12. The precipitation adjustment factor was removed from the daily 24-hour emission calculation for wind erosion from stockpiles. This was requested by EPA in comments on the September 1994 modeling report.

13. The emissions from the oversized ore pile at FMC were recalculated considering the percent fines and percent moisture content of baghouse fines, which are included in this source. The previous inventory assumed all of the material present in the oversized ore source were stone-sized pieces of phosphate ore. This change resulted in increased emissions.

14. Metal emissions from the pressure relief valves (PRVs), phos dock, and the secondary CO flares at FMC were added to the new inventory using new information supplied by FMC. The metals content in these sources was based on impurities in the P_4 product; the amount of P_4 in the gas stream was based on a material balance reported in FMC, 1995. *Radionuclide emissions from these sources were assumed to be zero because EPA source* data (EPA, 1978b) indicated that only negligible amounts of radionuclides were emitted from the CO flares.

15. Point source emissions from the east and west shale baghouses were recalculated using source test values based on lb/hr of operation, rather than material transfer calculations found in *AP-42*. This increased point source emissions from these two sources.

16. The silt content of the slag pile was adjusted to compensate for the abundance of very large blocks of slag that could not be characterized using the sampling methodology recommended in *AP-42*. The texture of the fine-grained material collected from small hollows near the base of the pile was used in the previous inventory to characterize windblown particulate emissions from the static stockpile. These samples were not characteristic of the overall texture of the stockpile, which is comprised largely of blocks of slag typically several feet or greater in size. This change is unrelated to particulate emission rates associated with hot slag dumping onto the stockpile and cold slag excavation from the slag pile (Section 3.3.2).

17. Control efficiencies for some process operations were revised for consistency with the 1992 SIP inventory when no other information was available.

18. Radionuclide emissions from the FMC dust silo, and east and west baghouses were inadvertently omitted from the September 1994 emission inventory. These sources have now been added to the current CERCLA inventory.

19. In response to EPA comments and reconsideration of source test results for the FMC slag pit, fluoride emissions, which were undetected in the slag pit source test results, were added to the emission inventory based on the concentration of fluoride in cold slag and engineering judgment.

20. Simplot road lengths in previous inventories were overestimated on a per-trip basis. These lengths were corrected. These same roads were also incorrectly summed as input to the model and did not represent the intended vehicle traffic on each road segment. This correction had the effect of spreading out vehicle traffic over the facility, whereas the previous study had incorrectly modeled these road emissions as though they originated from only one segment of the road network.

21. It was noted that only one of Simplot's cooling towers had building downwash factors included in the InterISC2 model input. This was determined to be incorrect because each of the three adjacent towers influenced the others to some minor extent. Revised building downwash factors adjusted the model accordingly.

22. The PM_{10} and TSP fractions for several Simplot point source emissions had inconsistent capture and control values. These values were corrected.

23. Building downwash parameters were estimated for BAPCO point sources, based on approximations of building dimensions identified from plant layout and aerial photographs. This was done so that the approach used to model emissions from BAPCO

point sources would be consistent with that used to model FMC and Simplot point sources. The BAPCO point sources had low-level emission points that should be subject to downwash effects.

24. Model sensitivity runs were conducted to evaluate model source characterizations. Based on these, the number of sources modeled as volume sources was increased from four to twenty. This change resulted in a slight increase in model-predicted concentrations.

25. Stack parameters and emission characteristics from the two FMC calciners were reviewed and modified based on revised information provided in source tests performed by FMC.

3.1.2 PURPOSE AND REPRESENTATIVENESS OF THE INVENTORIES

An emission inventory is a catalogue of emission sources and associated constituent emission rates. The inventories developed in this study have been compiled as EXCEL™ Workbooks. Sources are categorized as point sources (e.g., stacks and vents), area sources (e.g., fugitive emissions from process equipment or windblown emissions from stockpiles), and line sources (e.g., fugitive emissions from roads).

Emission rates were developed for each source to describe typical daily conditions and average annual plant conditions characteristic of the period between October 1, 1993 through September 30, 1994. These rates were developed from either source tests or were calculated using methods presented in EPA's *AP-42* guidance manual (EPA, 1985, 1986b, 1988c, 1990d, 1991e), which is the standard reference manual for this purpose. The state of Idaho published a PM_{10} emission inventory for BAPCO (IDEQ, 1992); this was used with the modifications described in Section 3.3.9 and elsewhere in this section to characterize BAPCO emissions.

3.1.2.1 Maximum Emission Rate versus Typical Rate

The inventories prepared for this CERCLA investigation differ from the more traditional permitting inventory developed under Clean Air Act (CAA) regulatory programs. The "potential to emit" from the facility (i.e., the maximum a facility or source *could* emit for regulatory

permitting purposes) is not relevant in this analysis. Permits are already in effect that establish maximum limits on emissions from major sources at the EMF facilities.

Rather, these inventories address a specific objective to the CERCLA RI/FS process—to identify sources that contributed to the constituent levels detected during the monitoring program. EPA has elected to use data collected by the air monitoring program to assess risk levels attributable to EMF facility emissions.

For this purpose, the model must simulate emissions from each source that were characteristic of emissions over the monitoring period. If sources were modeled using uncharacteristic emission rates, the model might incorrectly identify culpable source(s), resulting in remedial action alternatives for the wrong source. To avoid this potential problem, the emission inventories were based on typical emission profiles, rather than maximum potential emission estimates contained in the 1992 SIP inventory. Several examples will help explain these points.

The first example is shale reclaiming at FMC. Although there are two shale reclaim piles, there exists only one reclaimer wheel. This wheel alternates between the two reclaim piles, thus precluding the operation of the second pile while the first one is in operation. Therefore, as shale is being reclaimed from one ore pile, only the set of conveyor belts associated with that pile is operating. Emissions from shale reclaiming were overstated in the SIP inventory due to double-counting these conveyor emissions.

A second example is the briquetting building. Numerous material processing systems exist within this building. Some of these systems listed in the current inventory are backup process units which operate only when the primary unit is out of service. Including daily emissions in the inventory for these backup units (as was done in the 1992 SIP inventory) would tend to overestimate particulate emissions, since the simultaneous operation of both the primary and backup units does not occur.

In both these cases, the FMC emissions inventory was adjusted to reflect the typical daily operations of only one set of operating conveyors and the normal configuration of the briquetting building. Emissions from both these activities were included in the annual emissions inventory.

Redundant sources such as those present at FMC do not exist at the J. R. Simplot facility, thereby eliminating the possibility of double-counting emissions.

3.1.2.2 Long-term Emission Rates versus Typical-year Rates

As shown in Figure 3.1.2-1, production rates at FMC during the 1993/1994 period of monitoring are comparable with production rates over the past five years. Four electric arc furnaces at FMC produce elemental phosphorus. In response to market conditions, scheduled maintenance, power availability, and operational constraints, there were occasions during the monitoring period when fewer than four furnaces were fully operational.

During the period between October 1993 and February 1994, Idaho Power Company frequently reduced electric power to FMC in response to reduced power generation or increased demand within the power grid. As a result, FMC frequently operated three furnaces, but maintained the fourth furnace in a stand-by condition as power became available for use.

Table 3.1.2-1 compares monthly P_4 production over the period of air monitoring with 1990, when four furnaces were routinely used. Production rates during the air monitoring study varied between a low of 66% (April 1994) to a high of 100% (March 1994) with the average production at 83%. The average annual emission inventory assumes that four furnaces operated 85% of the time. The daily emission inventory, however, assumes that all four furnaces operated every day.

At Simplot, production rates for core products set new records and surpassed the 1992-93 levels by 10% (Figure 3.1.2-2). Operating factors for major emission sources, however, were within the 60-95% range. Source operating conditions and throughputs used in calculating average annual and daily emissions were based on the 1993-94 period to the extent possible.

TABLE 3.1.2-1
FMC P_4 PRODUCTION COMPARISON

COMPARISON MONTHS	DIFFERENCE
10/93 vs. 10/90	79%
11/93 vs. 11/90	71%
12/93 vs. 12/90	72%
1/94 vs. 1/90	85%
2/94 vs. 2/90	77%
3/94 vs. 3/90	100%
4/94 vs. 4/90	66%
5/94 vs. 5/90	95%
6/94 vs. 6/90	96%
7/94 vs. 7/90	98%
8/94 vs. 8/90	90%
9/94 vs. 9/90	77%
10/94 vs. 10/90	85%
Weighted Average	83%

Some emission rates are not directly correlated with industrial production rates at either facility. In many cases emission factors in units of lbs/hr (usually a source test) indicate that emissions from that source are not production-rate-based; instead, they are based on the operational hours of that source. In instances where emission factors are in units of lbs/ton, emissions are based on a production rate.

The Granulation #3 area source emissions at Simplot (emission factor of 0.02 lb/ton) are an example of production-rate-based emissions. Emissions from this kind of area source are proportional to the amount of material processed (e.g., emissions increase when more material is processed and decrease when less material is processed). In general, both facilities have area sources whose emissions are production-rate-based.

An example of non-production-rate-based emissions that are solely dependent upon hours of operation, is the dust silo baghouse at the FMC facility (3.1 lbs/hr). Sources such as a baghouse or controlled stack are not dependent on the amount of material handled by the process. Baghouses have emissions which are a function of the air flow and fabric-collection efficiency. Emissions from the exit side of the baghouse remain relatively constant for the same air flow and are independent of variations in the feedrate of the controlled process. The 1992 SIP inventory also contained emission factors in units of both lb/hr and lb/ton, as did the CERCLA inventory used in this modeling effort.

3.1.2.3 Daily Emission Inventory

Typical daily emission inventories were developed as requested by EPA Region 10 for use in evaluating model performance. EPA's recommended model performance criterion (Cox, 1988) is that model predictions should be within a factor of two of the daily monitored levels of site-related constituents, after adjusting model-predicted levels with background levels. This approach is commonly used in model performance evaluations for SIP and CAA permitting projects. These daily concentrations were compared with data from the ambient air quality monitoring program to assess model performance (Section 5.3).

The daily emission rate was established in one of two ways. For processes that operate continuously, the daily emission rate assumed that emissions occurred 24-hours per day. Sources within this category can be identified in the emission inventories (Appendix AE) where "24-hrs/day" is shown under the column heading titled "hours/day." Further information on the approach used to establish emission rates for this category of sources is presented in Section 3.3 and in Appendix AE.

For processes that do not operate continuously, the daily emission rate was set at the typical operation period for the source. Sources within this category can be identified in the emission inventories (Appendix AE) where something other than "24-hr/day" is shown under the column

heading titled "hours/day." Further information on emission rates for this category of sources is presented in Section 3.3 and in Appendix AE.

This approach was not followed for the BAPCO emission inventory due to the lack of access to site-specific production rate data. Thus, the rates provided in the 1992 SIP emission inventory were assumed to be typical for BAPCO.

In most cases, the daily emission rate does not equate to a design maximum or permitted maximum emission rate for a source. In addition, redundant process systems, which are impossible to operate concurrently, were not counted in the inventory as concurrently operational sources.

The daily emission rates are typically greater than or equal to the annual average emission rate for the source, as discussed below. The aggregate effect of this approach should be a modest overestimation of actual daily emissions rates and resulting predicted ambient constituent concentrations. Processes do not typically operate for a full 24-hour period for extended periods, nor are typical operation rates for noncontinuous sources sustained at such levels for extended periods, due to interruptions for routine maintenance and equipment repairs.

In addition, some sources operate seasonally or only occasionally, such as ore stacking at FMC (summer only), building of the silica pile at FMC (briefly every two years), or ferrophos crushing at BAPCO (as needed). The influence of infrequent or seasonal operations was evaluated by case study analyses during model performance evaluation (Appendix AJ).

At the request of EPA, windblown fugitive dust sources previously calculated with a factor reflecting annual precipitation rates were instead estimated on a daily basis assuming no precipitation, which overestimates these sources. Precipitation adjustments were included in daily case study analyses where appropriate.

3.1.2.4 Average Annual Emission Rate

The average annual emission rate is that emission produced from a source over the course of the one-year period, coincident with the ambient air monitoring program. All sources were assumed to be operating at typical conditions. The average annual emission rates were originally developed for the September 1994 modeling study to estimate average annual constituent concentrations in ambient air. These concentrations (or activities, in the case of radionuclides) were developed for EPA's use in evaluating potential risk associated with chronic exposure to ambient air.

The average annual emission rates were retained in the emission inventories because FMC and Simplot believe that they continue to serve as a better indication of plant emissions over the period of study than do daily emission rates. As shown in Section 5.2, long-term average constituent concentrations in ambient air obtained from a statistical review of monitoring samples are similar to average annual constituent concentrations predicted by the model, after adjustment for background contributions. Thus, the source culpability list derived from modeling average annual emissions will better support the remedial action assessment process in the FS than would the identification of sources derived from modeling based only on daily emissions.

3.1.3. Constituents Included in the Inventories

Emission inventories were prepared for the following constituents: particulate matter of less than or equal to 10 microns (PM_{10}), total suspended particulate (TSP), antimony, arsenic, beryllium, cadmium, total chromium, total fluorides, lead, lead-210, nickel, total phosphorus, polonium-210, radium-226, -228, total silica, thorium-230, -232, uranium-234, -235, -238.

These constituents are derived from feedstock processed at the EMF facilities—ore mined from the Phosphoria Formation. This ore contains apatite, a mineral containing phosphate and fluoride. The ore also contains trace levels of arsenic, cadmium, chromium (total), uranium-238 (and related decay isotopic products), thorium-232 (and related decay products), and other

elements. The processing operations at the EMF facilities separate these components into various products, byproducts, and wastes.

Most of the above constituents were included in the previous inventories. PM_{10}-based radionuclide emissions were the basis for calculating all inorganic and radionuclide constituent emissions except total fluoride, which was based on TSP emissions.

In addition to being present in the industrial feedstock, these metals and radionuclides were selected because they may affect human health. The metals and total silica were listed in a proposed Risk Assessment Work Plan for the EMF site (E&E, 1992). Total phosphorus was included because of its association with the facilities' production operations. The radionuclides were previously evaluated by EPA to estimate the impact on public health by the facilities (EPA, 1978a and 1978b).

3.2 INFORMATION SOURCES

A numer of information sources were used to compile and revise the FMC and Simplot emission inventories. The main sources were:

- Communications with both facilities, site visits, updated information on process flows, throughput rates, operational periods, and stack source tests.
- Additional source emission characterizations conducted by both facilities, as described in Section 3.3.
- *AP-42*, the primary emission factor reference document published by EPA and its supplements for emission factors, PM_{10} fractions, and other miscellaneous information (EPA, 1985, 1986b, 1988c, 1990d, 1991c).

To account for all major emission sources, an in-depth material balance of air, water, and waste process streams was prepared (FMC, 1995). Data from this material balance was used to cross-check estimated air emissions from the FMC facility and to estimate emissions from CO flares.

Publications used in compiling the inventories include:

- FMC Inspection Report (PEI, 1986)
- FMC Control Technology Evaluation (EQM and EHP Associates, 1992)
- Pacific Northwest Speciation Profile Library (Core, 1989)
- Air Emissions Species Manual (Volume 2) for particulate matter (EPA, 1990a)
- Final Guideline Document: Control of Fluoride Emissions from Existing Phosphate Fertilizer Plants (EPA, 1978)
- Radiological Surveys of Idaho Ore Processing – The Thermal Process Plant (EPA, 1978b)
- Radiological Surveys of Idaho Ore Processing – The Wet Process Plant (EPA, 1978a)
- Idaho Department of Environmental Quality, Draft State Implementation Plan Emission Inventory for PM_{10} (Idaho, 1992)

3.3 ADDITIONAL SOURCE CHARACTERIZATION

The need to refine the characterization of air emission sources at the EMF site was identified during discussions between the Companies and EPA Region 10 during late 1992 and early 1993. In its April 15, 1993 letter to the Companies, EPA Region 10 agreed with the Companies that the following Company-proposed sources would be further characterized:

FMC Corporation	J.R. Simplot
Furnace Tapping	Granulation #2 Cooler Baghouse
Slag Pit	Gypsum Stacks
Slag Pile	Roads
Roads	

Source characterization studies were conducted at each facility during the summer and fall of 1993. All samples were collected and analyzed by Chester, with the following exceptions. Bechtel collected the road samples and gypsum stack samples; road samples were analyzed by Chester; and gypsum stack samples were analyzed by Mountain States Analytical. The data obtained from these source tests are presented in Sections 3.3.1 through 3.3.8. These sections include a comparison of the emission rates calculated using these source tests with the previous emission inventory [(hereinafter termed the "1992 inventory" that was reported in Bechtel 1993a)].

3.3.1 FMC FURNACE TAPPING

Furnace tapping emissions at FMC result when of hot liquid slag and metal drain from ports in the electric arc furnaces to the slag pit area outside the furnace building. These emissions are captured in collection hoods and are controlled by a series of Medusa/Anderson scrubbers. FMC had prior stack test data on the Medusa/Anderson scrubbers for PM_{10}, TSP, and fluoride. The furnace tap hood vents were sampled in 1989 for 74 chemical species for inclusion in the Pacific Northwest Source Profiles Library (Core, 1989).

In October 1993, source testing was conducted at the furnace tap hood inlet, where furnace tapping emissions originate. Sampling was conducted by Chester at the #4 furnace. The objective was to characterize unscrubbed fugitive emissions. Results from this test were presented in two reports: *Tap Hood Emissions Testing Furnace #4 - Test Report and Tap Hood Emissions Testing Furnace #4 - Analytical Report*, (Chester, 1994a and 1994b). These reports describe sampling procedures, analytical methodologies, and results. This section presents an overview of the two Chester reports; further information is found in the reports. These reports were submitted to EPA Region 10 in support of revisions of the SIP.

The following compounds were analyzed in the furnace tap hood vent emissions:

- Metals
- Hexavalent chromium
- Radionuclides: Po-210 and Pb-210
- PM_{10}
- P_2O_5 (reported as phosphorus)
- Fluorides
- TSP

Each furnace has four tap holes: two for slag discharge and two for metal discharge. Testing was conducted on FMC's furnace #4 during typical metal (i.e., ferrophos) tapping events, which occur approximately every eight hours. A metal tap lasts approximately 25 minutes. Testing was also conducted during typical slag tapping events. Slag is tapped from alternate sides of a furnace for approximately 35 minutes per operating hour (FMC Corporation, 1995a). During the remaining 25 minutes of each hour, no emissions are generated. These operational periods were used to calculate the uncontrolled and fugitive emission rates. Thus this source is actively emitting 15.25 hours over a 24-hour period, as shown in the emission inventory in Appendix AE.

The furnace tap hood emission rates are presented in Table 3.3.1-1. The table presents the analytes, average metal and slag tap emission rates, and time-weighted average tap emission rate

for both types of tapping. All emission rates are stated in lbs/hr except for radionuclides, which are stated in microCuries per hour (μCi/hr).

The TSP emission rates used in the revised inventory are the average of the TSP emission rates determined for samples collected during slag and metal tapping. Three sets of samples were collected during metal and slag tapping. One set was analyzed for P_2O_5, the second for metals, and the third for fluoride (Table 3.3.1-1).

Fugitive furnace tapping emissions from each of the furnaces were estimated in the 1992 emission inventory by back-calculating the emissions from the stack tests done on the Medusa/Anderson scrubbers. The back-calculation was performed by applying a scrubber control efficiency and capture efficiency factor to the stack test results. More information regarding the calculation is presented in Appendix B of "Air Dispersion Modeling for Monitoring Site Locations for the Eastern Michaud Flats Site" (Bechtel, 1993a). These estimates have been replaced using the time-weighted 1993 characterization data to characterize fugitive emissions from this source.

In commenting on the September 1994 modeling study, EPA (1994a) questioned whether the source characterization results represented the typical operation of the furnace tapping system. A supplemental analysis, presented to EPA in a meeting on February 23, 1995 by TRC, Inc. (successor to Chester), demonstrated that the emission characterization from this source was representative of typical operating conditions (Appendix AM).

Samples of furnace tapping emissions were collected over a period of five consecutive days. A total of 56 test runs were conducted, and four replicate runs were conducted for each type of emission test. This exceeded EPA's Reference Methodology for stationary source emissions, which require 3 replicate tests to demonstrate compliance with permitted emission limits.

The amount of burden (burden is a term used to describe the standard mixture of ore, coke, and silica added to the furnace) processed in an electric arc furnace at FMC correlates with electric

power utilization in the furnace. Power utilization also correlates with the amount of slag withdrawn from the furnace. Based on their history of operating experience, FMC has developed a correlation factor that equates electrical loading to slag production.

FMC has also determined electrical loading to be an indicator of good operating practice for the furnaces. The electrical loading of furnace #4 during the tap hood vent testing was typical of the average condition. Consequently, furnace #4 was operating in a typical and representative manner with respect to both production standards and the productivity of the other 3 furnaces during the testing period. FMC believes that the characterization of furnace tapping emissions performed in October 1993 is representative of typical furnace operations.

Emission Inventory Revisions

Table 3.3.1-2 presents the emission rates for the furnace tap hood fugitive sources from the revised and 1992 inventory. Please note that Table 3.3.1-2 and subsequent tables present data for the constituents used in atmospheric dispersion modeling.

In the 1992 inventory, metal emission rates were calculated as a percentage of PM_{10}, based on data contained in the Pacific Northwest Profile Library (Core, 1989). Metals emission rates in the revised inventory are based primarily on source emission tests, rather than correlations with data from the profile library. In some instances (secondary condensor flare or PRVs) metal emission rates are based on mass balance information provided by FMC. With the exception of beryllium, all metal emission rates increased. Beryllium was not detected in the 1993 source test; silica was neither analyzed nor calculated in either inventory.

Hexavalent chromium was not detected in the emissions. However, due to differences in Cr^{+6} and total chromium detection levels experienced during the analysis and other factors, the potential Cr^{+6}/total chromium ratio is considered to be less than 1%. Further discussion is presented in Appendix AK.

The 1992 inventory did not include radionuclides, due to the lack of data. However, lead-210 and polonium-210 were analyzed during the 1993 source test. The lead-210 emission rate was found to be 3.18E+6 pCi/hr (3.18 μCi/hr) and the polonium-210 rate was 1.55E+06 pCi/hr (1.55 μCi/hr) (Table 3.3.1-1).

3.3.2 FMC SLAG PIT

During slag tapping, molten slag exits the south side of the furnace building through runners leading from each furnace tap hood into the slag pit. The slag cools and solidifies within the pit to a point were it can be excavated by a front-end loader and loaded into 50-ton-capacity trucks for transfer to the slag pile. The slag pit is approximately 220 feet wide and approximately 15 feet below grade along the south side of the furnace building. The base of the pit slopes upward toward the south, away from the furnace building.

Source testing conducted on the slag pit operations was performed by Chester in October 1993; methodologies and results were presented in "Determination of Emission Factors for Slag Handling Operations at FMC Plant Pocatello, Idaho - Final Report," (Chester, 1994c). This section presents an overview of the source test results. Further information is found in the above report. Emissions from slag pit operations were previously estimated using comparable processes (in iron and steel industries) from guidance available in AP-42 (EPA, 1986). For more information regarding those calculations, please refer to the report *Air Dispersion Modeling for Monitoring Site Locations for the Eastern Michaud Flats Site* (Bechtel, 1993a).

The Chester report was submitted to EPA Region 10 in support of revisions of the SIP. However, EPA believes that the characterization results are not representative of emissions during the sampling campaign, and has declined to use the emission characterization data in its SIP rule-making. FMC agreed to resample emissions from this source and submitted a revised sampling protocol to EPA on April 10, 1995. EPA and FMC are currently discussing the sampling protocol.

Results from this resampling will not be available before the anticipated submission date of this EMF RI Report. Consequently, data from the 1993 characterization have been retained in the inventories and modeling study.

The following compounds were analyzed in the slag pit emissions:

- Particulate total mass
- Particulate elemental (metal) species
- Particulate hexavalent chromium
- Particulate sulfate (SO_4), phosphate (as P_2O_5), and particulate fluoride
- Sulfur dioxide (SO_2)

Nine potential sources of fugitive PM_{10} and TSP emissions from the individual slag handling operations were identified and tested. These were:

- Slag tapping
- Slag quenching
- Excavating hot slag from the pit
- Loading hot slag into haul trucks
- Dumping hot slag from haul trucks onto the slag storage pile
- Excavating cold slag from the slag storage pile
- Dumping cold slag into the pit for lining and dressing
- Dumping cold fines onto the fines pile
- Dumping cold fines onto the pit and dressing the pit

The last three operations dealing with cold slag/fines dumping were combined into one source called "cold slag dumping." The results of the tests performed for each of these operations are presented in Tables 3.3.2-1 through 3.3.2-7. These tables present the analyte and the average amount of each analyte in the PM_{10} and TSP fractions.

Two of the operations are located on the slag pile:

- Dumping hot slag from haul trucks onto the slag storage pile
- Excavating cold slag from the slag storage pile

Emissions from these operations are included in the source called slag pile emissions in the revised emission inventory.

Tables 3.3.2-8 and 3.3.2-9 describe the emission rates for slag pit operations from the 1992 and revised emission inventories, respectively. The names of the handling operations characterized in 1993 have replaced the designations used in the 1992 inventories. As a result, nomenclature used to describe the slag pit operations and associated emissions differs slightly between the 1992 and revised inventories.

For comparison of the data, the following operations are considered synonymous:

Revised Inventory	**1992 Inventory**
Slag quenching	Slag quenching with water
Hot slag excavation	Slag digging
Hot slag loading	Drop into truck for pile
Hot slag dumping	Dump slag into holding pile
Cold slag excavation	Pick up slag from holding pile
Cold slag dumping	Truck dump => slag pit
Hot slag tapping	———

No equivalent operations exist in the 1992 inventory for hot slag tapping. It was assumed that since the tapping occurred on the inside of the furnace building, emissions from this activity would be included with the tap hood emissions. Slag tapping emissions were incorporated into the revised emission inventories as stated in Section 3.3.1. The 1992 inventory used iron and steel mill electric arc furnace emission factors from *AP-42* (EPA, 1986b), which only approximated the actual emissions from the slag generated by a phosphorus production facility.

A control factor of 50% was assumed during the slag quenching operation in the 1992 inventory. Since the current inventory is based on direct measurements, no control factor was applied.

The PM_{10} and TSP daily and average annual emission rates decreased significantly in the revised inventory. This change is due to facility-specific sampling results.

Fluoride was not detected in the 1993 emission characterizations, but detection levels for some sources were high due to small-sample volume. Consequently, average fluoride levels measured in cold slag (reference Section 4.2 of Part II of this RI Report) and particulate phase fluoride levels in the tap hood vent (as reported by Chester) were combined to establish fluoride levels in PM_{10} and TSP fractions. The cold slag concentrations ranged from 1.24 to 1.78% wt., with an average of 1.58% and standard deviation of 0.18%. The tap hood vent samples showed detects at no more than 1.7% wt. of the total particulate measured, with an average of 1.0% and a standard deviation of 0.39%. Combining both data sets provides an average fluoride content of 1.35% of the total particulate mass.

The daily and average annual emission rates for antimony increased in the revision, whereas the daily emission rates for total chromium, nickel, beryllium, and lead increased while the average annual emission rates decreased. Hexavalent chromium was not detected in any emission samples. However, due to differences in Cr^{+6} and total chromium detection levels during the analysis and other factors, the potential Cr^{+6}/total chromium ratio in slag-handling operations is considered to be less than one percent. Further information on this subject is presented in Appendix AK. The daily and average annual emission rates for all other metals decreased.

3.3.3 FMC Roads

An atmospheric dispersion modeling study of ambient air quality completed in 1992 (Bechtel, 1993a) suggested that emissions from roads within the FMC facility contributed to the modeled offsite estimates of PM_{10} and TSP. However, limited data were available to characterize road emissions in that modeling study, and various assumptions were used to characterize road dust

constituents. After consulting with EPA Region 10, FMC determined that additional road sampling would provide a better characterization of potential emissions.

Road dust samples were collected during August 1993 within the FMC facility in accordance with the methods presented in "*AP-42* Appendix D – Procedures for Sampling Surface and Bulk Materials" (EPA, 1990d). The samples were analyzed by Chester for particle size distribution, moisture, and inorganic constituents.

Table 3.3.3-1 shows the road/site description, road number, road type (paved or unpaved), number of samples from each road, and type of analysis performed on the samples. In instances when there were more than one sample per road, the samples for that road were combined into a composite sample for metal analysis. The road numbers reflect the first three characters found in the sample ID number. XRF analysis was used to identify the metal in the matrix sample and Cr^{+6} was analyzed using NIOSH method 7600.

At FMC, 41 individual samples were collected: ten samples from paved roads, 21 samples from unpaved roads, and ten samples from the slag pile. Twelve composite samples were made: four from the paved roads, seven from the unpaved roads, and one from the slag pile. Figure 3.3.3-1 shows the sampling locations.

Laboratory analysis of the samples was performed according to *AP-42*, Appendix E (EPA, 1990d). Fourteen particle-size fractions were determined for all samples using ASTM method D422-63 (Chester, 1993). Particle sizes larger than 75 microns were identified by the sieving process. Particle sizes smaller than 75 microns were identified by sedimentation.

All composite samples were analyzed for metals: four composite samples and one individual sample were analyzed for Cr^{+6} (Table 3.3.3-1). Metals were analyzed for three size fractions in each sample: TSP (less than 30 microns), PM_{10}, and fines (less than 2.5 microns).

The amount of particulate in the TSP and PM_{10} fractions have been used in the TSP and PM_{10} inventories, respectively. The metal inventories use the fraction of the metal in the PM_{10} sample multiplied by the amount of PM_{10} in the sample.

EPA recommended procedures were used to calculate the revised road emission rates [*AP-42*: Section 11.2.1 for unpaved roads and Section 11.2.6 for industrial paved roads (EPA, 1990b)]. Because *AP-42* equations require aerodynamically equivalent sizes, approximate aerodynamically equivalent sizes for PM_{10} were calculated according to the instructions in Chester's data package (Chester, 1993).

PM_{10} and TSP data were extrapolated from sampled roads to unsampled roads, based on proximity, whether paved or unpaved, and the similarity of road surface materials. Road samples at FMC used to represent inventory segments are listed below.

ROAD SAMPLE NUMBER	INVENTORY ROAD NUMBER	ROAD SAMPLE NUMBER	INVENTORY ROAD NUMBER
F17	8	F22, F23	24
F17, F11*	29, 30, 31	F21	25
F17, F11	28	F23	23A
F11*	10, 12, 13, 14, 15, 16	F02	116
F04, F05	6, 7, 9	F21	32
F22	18	F26, F23	27
F17, F21	18A, 19, 20		

* Sampled paved road data were extrapolated to obtain unpaved road emission factors.

Table 3.3.3-2 presents four area sources, the roads associated with the sources, and the type of road (paved or unpaved). All of these sources encompass both paved and unpaved roads. Nine of the roads were paved in October 1993, to further reduce emissions at the facility; these roads are listed as "unpaved to paved."

Table 3.3.3-3 presents a summary of the 1992 and revised emission rates for paved roads. FMC's PM_{10} and TSP road emission rates decreased significantly for all sources in the revised inventory. This change is attributed to the use of facility-specific sampling results, whereas the 1992 inventory used assumptions on particle sizes in road dust based on EPA *AP-42* estimations.

The metal mass fractions from the sampled roads were averaged over the corresponding area to obtain the emission rate for the area. The differences between the 1992 and revised inventory for the slag pile and roads are as follows:

- All total silica and total phosphorus emissions increased from zero due to new site-specific data obtained during the sampling.
- All antimony emissions decreased to zero.
- Arsenic emissions decreased to zero for the roads centered on the slag pit and pond area.
- All metal emission rates decreased for the roads centered on the slag pit, slag pile, and ore, except for arsenic in the slag pile and ore, and total silica in the slag pit, slag pile, and ore.
- Particulate emission rates declined for all roads except those centered in the pond area.

Table 3.3.3-4 presents a summary of the 1992 and revised emission rates for all FMC roads.

Five road segment samples from FMC were subsequently analyzed for Cr^{+6}. This analysis was extended to the individual mass fractions (TSP, PM_{10}, and fines). All but one of these analytes were nondetects, with detection limits ranging between less than 1μg/g (microgram per gram) to several hundred μg/g. A detected value of 26 μg/g was obtained for one sample (F21C). After validation, all values of Cr^{+6} were judged nondetects for all roads analyzed. A further discussion of the Cr^{+6} data is presented in Appendix AK.

3.3.4 SLAG PILE RESULTS

Two of the slag handling operations characterized by Chester in 1993 (Section 3.3.2) are conducted on the slag pile at FMC:

- Dumping hot slag from haul trucks onto the slag storage pile
- Excavating cold slag from the slag storage pile

During slag tapping, molten slag exits the side of the furnace building through runners from each furnace tap hood into the slag pit. The slag cools and solidifies within the pit, then is loaded onto 50-ton-capacity trucks for transfer to the slag storage pile. The trucks drive to the slag storage pile and dump the slag on to the storage pile. This activity is known as "hot slag dumping".

Periodically, cold slag from the slag pile was excavated for crushing at BAPCO or for other uses within the FMC facility. Slag is excavated by front end loader and transported to other areas at the plant. This activity is known as "cold slag excavation". Emissions for these two activities are summarized in Tables 3.3.2-5 and 3.3.2-6.

In addition to these activities, windblown emissions from the static slag pile were also estimated. Slag pile samples were collected during August 1993 along with the road dust samples. The samples were analyzed by Chester for particle size distribution, moisture, and inorganic metals. Samples were collected in accordance with the methods presented in *AP-42 Appendix D – Procedures for Sampling Surface and Bulk Materials* (EPA, 1990a) from small hollows in the top of the pile and near its base.

Subsequent to submission of the September 1994 modeling report, it was recognized that the fine-grained samples collected in August 1993 are not representative of the overall texture of the slag pile. The pile is comprised of an overwhelming abundance of angular blocks of hardened slag, each typically several feet in size. These blocks, which are clearly too large and heavy to be subject to windblown dispersion, were also too large to be sampled.

The measured particle size from the August 1993 sampling showed the silt content of the slag surface to be 2.82%. By observation, the slag pile was covered with one-to-twenty-four-inch diameter rock, with some greater than sixty inches in diameter. Except for one or two areas, no sand-sized material was seen on the surface. The patches of sand-sized materials appeared to comprise less than 1% of the total surface area of the slag pile. Because the sampling technique did not allow for sampling of the larger size material from the pile, data obtained with this method overstate potential fugitive emissions.

To obtain a more representative silt value for the slag pile, the particle size distribution during the August 1993 sampling was plotted on log-normal probability paper to account for the larger particle sizes present in the slag. The results of this analysis indicate that a representative silt value for the slag pile would be approximately 100 times less than the 2.82% (0.028%) obtained in the composite slag pile sample. Consequently, windblown emissions from the slag pile reported in the September 1994 modeling study have been revised.

Table 3.3.4-1 presents a summary of the slag pile emission rates for the 1992 and revised inventory. This table reflects both windblown emissions and emissions associated with hot slag dumping and cold slag excavation.

The differences between the 1992 and revised inventories for the slag pile are as follows:

- PM_{10}, TSP, and fluoride emission rates decreased significantly.
- Antimony was not included in the 1992 inventory. It was not detected with a deep XRF scan in the samples collected for the 1994 inventory, and its emission rate was set at zero.
- Arsenic and chromium (total), cadmium, beryllium, and silica decreased by one order of magnitude, and lead by two orders of magnitude in the revised inventory.
- Nickel increased by two orders of magnitude.

3.3.5 SIMPLOT GRANULATION #2 BAGHOUSE

The Granulation #2 baghouse, formerly called the di-ammonium phosphate (DAP) baghouse, was previously sampled for TSP and fluoride. In 1993 the Granulation #2 baghouse was again sampled using EPA Method 5 for five hours to collect enough particulate matter for a filter analysis. Filter analysis included particulate metals, total phosphorus, and fluoride. The results of the Granulation #2 baghouse source test are presented in Table 3.3.5-1. The table presents the analytes and their associated source test values in pounds per hour (lb/hr).

Table 3.3.5-2 presents the 1992 and revised emission rates for the Granulation #2 baghouse point source. The source emission rates increased for PM_{10}, TSP, cadmium, total chromium, and nickel. For arsenic and beryllium, the emission rates decreased to zero.

3.3.6 SIMPLOT GYPSUM STACK

Gypsum stack emissions were estimated using procedures outlined in the EPA *AP-42* guidance document (EPA, 1988c). Because gypsum forms a firm crust, particulate emissions can only occur when the material is mechanically disturbed, as during the occasional creation of dikes to create temporary ponds for the slurry. For purposes of the 1994 modeling study, this has been acknowledged by local IDEQ officials. The area of mechanical disturbance on the pile was calculated from the amount of gypsum excavated to build a typical dike (i.e., approximately 8.1 million cubic feet).

Because of this crusting characteristic, obtaining a friable sample of gypsum for particle size re-suspension and analysis was deemed inappropriate. As a substitute for this source characterization, a composite sample was collected from the gypsum stack slurry solids (which forms the base material) and analyzed for a variety of metals. Table 3.3.6-1 indicates the analyte and the concentrations.

The gypsum stack emissions for the 1992 and revised inventories are presented in Table 3.3.6-2. The PM_{10}, TSP, and fluoride emission rates increased slightly. Antimony emission rates

increased from zero, while other metal emissions decreased in various amounts, some up to several orders of magnitude.

3.3.7 SIMPLOT ROADS

An atmospheric dispersion modeling study of ambient air quality completed in 1992 suggested that emissions from roads within the Simplot facility contributed to the modeled offsite estimates of PM_{10} and TSP. However, the data and assumptions used to characterize road emissions in that study were limited. After consultation with EPA Region 10 (reference Section 3.3.3, FMC Roads), Simplot determined that additional road sampling would provide a better characterization of potential emissions with EPA in agreement.

Road dust samples were collected within the Simplot facility in accordance with the methods presented in *AP-42, Appendix D – Procedures for Sampling Surface and Bulk Materials* (EPA, 1990d) during August 1993. The samples were analyzed by Chester for particle size distribution, moisture, and inorganic constituents.

Table 3.3.7-1 shows the road/site description, road number, road type (paved or unpaved), number of samples from each road, and type of analysis performed on the samples. In instances when there were more than one sample per road, the samples for that road were combined into a composite sample for a metal analysis. The road numbers reflect the first three characters found in the sample ID number. XRF analysis was used to identify the metal in the matrix sample and Cr^{+6} was analyzed using NIOSH method 7600.

Six samples were collected on two paved roads. Two composite samples were made, one for each road. Two paved roads were sampled: the road around the Granulation #3 (formerly called triple super-phosphate) unit and the road around Granulation #1 and #2 units (i.e., the mono-ammonium-phosphate and di-ammonium-phosphate units, respectively). Three samples were taken from each road and made into a composite sample, which was then resuspended in the laboratory to

determine particle size distribution and analyzed for inorganic metals. Figure 3.3.7-1 shows the location of each of the samples. The unpaved roads were not sampled.

Laboratory analysis of the samples was performed by Chester, according to *AP-42 Appendix E* (EPA, 1990c). Fourteen particle-size fractions were determined for all samples using ASTM method D422-63 (Chester, 1993). Particle sizes larger than 75 microns were identified by the sieving process. Particle sizes smaller than 75 microns were identified by a sedimentation process.

All composite samples were analyzed for metals and hexavalent chromium (Table 3.3.7-1). Metals were analyzed for three size fractions in each sample: TSP (less than 30 microns), PM_{10} (less than 10 microns), and fines (less than 2.5 microns).

The amount of particulate in the TSP and PM_{10} fractions have been used in the TSP and PM_{10} inventories, respectively. The metal inventory uses the fraction of the metal in the sample multiplied by the amount of PM_{10} in the sample.

Chester used the EPA-recommended procedure to obtain the revised road emission rates [(i.e., *AP-42, Section 11.2.6 for Industrial Paved Roads* (EPA, 1990c)]. They analyzed the road samples using a method which presented the results based on the true physical sizes of the particles rather than their aerodynamic equivalent sizes. Because the *AP-42* equation requires the use of aerodynamic equivalent sizes, the approximate aerodynamic equivalent sizes for PM_{10} were calculated according to the instructions in Chester's data package (Chester, 1993).

In the 1992 inventory, the roads were grouped into two area sources centered on a specific plant geographical area. For the revised inventory, the road groupings were changed to five line sources to more accurately reflect the locations of the actual roads for air modeling purposes. Table 3.3.7-2 presents the 1992 and subsequently revised modeled roads sources, the roads associated with the sources, and the type of road (paved or unpaved).

Table 3.3.7-3 presents a summary of the 1992 and subsequently revised emission rates for the paved roads. Based on the frequency of travel over these roads, Simplot's S01C road sample was considered to be representative of all the roads in the ammonium-phosphate and ammonium-sulfate operations area of the facility, while the S02C road sample was considered representative of all roads in the triple super-phosphate operations area.

Simplot's PM_{10} and TSP emission rates decreased significantly in the revised inventory. This change is attributed to the use of facility-specific sampling result. The 1992 inventory based its road dust particle sizes on data obtained from EPA guidance *AP-42*.

The changes in the metal inventory were:

- Arsenic, antimony, beryllium, and cadmium emission rates in the revised inventory decreased to zero. These constituents were not detected in the road dust samples. Fluorides were also not detected.
- Total silica emission rates increased from zero. Total silica was detected in the new source sampling, whereas in the 1992 inventory silica was assumed to be negligible.
- Lead, nickel, and total chromium emissions decreased by a maximum of one order of magnitude.
- PM_{10} increased by a factor of one and a half; TSP increased only slightly.

The two road segment samples were additionally analyzed for Cr^{+6}. This analysis was extended to the individual mass fractions (TSP, PM_{10}, and fines) evaluated. The results of all but one of these analyses were nondetects, with detection limits ranging between less than 1 µg/g to several hundred µg/g; a detected value of 36.6 µg/g was obtained for one sample (ID number S02).

Although these were confirmed by data validation, the detected value is suspect. Operating characteristics at the Simplot facility do not offer an environment for chromium to oxidize into the hexavalent state. Further, Cr^{6+} was not detected in the TSP and fines fractions of this sample. The detection level in the TSP fraction was 21.3 µg/g, and the detection level in the fines fraction

was 216 μg/g. Thus, hexavalent chromium is not believed to be present in this sample. Further discussion of these results is found in Appendix AK.

3.3.8 OTHER SOURCE CHARACTERIZATION

Along with the additional characterizations requested by EPA, the Companies performed the following characterizations to refine emission profiles for other sources:

FMC Corporation	J. R. Simplot
Coke	Granulation #1 Reactor/Granulator
Ore	Granulation #1 Dryer
Calciner Stacks	Granulation #1 Baghouse
Baghouse Dusts	Granulation #2 Tail Gas Scrubber
Calciner Fines	Granulation #3 Scrubber
Oversized Ore Pile	Reclaim Cooling Tower
	Ammonium Sulfate Dryer
	Ammonium Sulfate Cooler

The Simplot sources were tested in 1993 for particulate matter, fluoride, and inorganic metals, in a manner similar to the Granulation # 2 Baghouse. These data were incorporated into the inventories.

The FMC ore, baghouse dusts, coke, crushed ferrophos, and calciner fines were suspended into PM_{10} and TSP fractions, which were analyzed for metals, inorganics, and radionuclides. These data have also been incorporated into the inventories.

Data from a 1993 calciner stack test performed by FMC included data on particulate matter, arsenic, cadmium, total chromium, lead, nickel, and polonium-210; these were also incorporated into the inventories. The calciner emissions are controlled by several sets of wet scrubbers. Each calciner can be operated in a one-lung or two-lung mode, and characterization data were collected for all mode configurations. The term "lung" represents a wet scrubber train that removes constituents from exhaust gases of the calciner. These high-efficiency emission control

devices operate in "one-lung" or "two-lung" mode, which refers to one or two scrubber trains in operation.

Average annual emissions rates from the calciners have been entered into the inventory as the weighted average emission rates of configurations used during the period of the modeling study. In the case of calciner #1, a one lung-mode was used during one-half of this period, and a two-lung mode was used during the other half. In the case of calciner #2, a one-lung mode was used during two-thirds of the period, and a two-lung mode during the remaining third.

To better characterize emissions, FMC requested that Chester re-evaluate existing samples of the PM_{10} fraction of slag, ore, calciner fines, coke, and crushed ferrophos using the XRF scanning level 9 protocol. These data have been added to the current CERCLA emission inventory. Beryllium was also analyzed in the same samples by ICAP. In the 1992 inventory, most beryllium emissions were estimated (Section 3.6.3).

3.3.9 BANNOCK PAVING INVENTORY

Bechtel received a copy of the state of Idaho's BAPCO PM_{10} emission inventory (October 1992 revision), prepared by OMNI Environmental Services, Inc. (IDEQ, 1992). This inventory used *AP-42* emission factors and facility operating data, and was based on the IDEQ's 1990 SIP emission inventory.

A common material present in the BAPCO facility is slag obtained from FMC. Bechtel modified BAPCO's PM_{10} inventory for slag-related sources to reflect the characteristics of FMC slag obtained from the revised FMC slag pile characterization. BAPCO's TSP emission inventory was developed by Bechtel, based on BAPCO's PM_{10} inventory, using the TSP emission factors and particle size information taken from *AP-42*, as well as the revised FMC slag characterization. Inventories for metals and radionuclides were prepared using data from FMC's source tests of the same material (i.e., slag and coke).

BAPCO's 1992 inventory contains emissions associated with silica crushing and silica mine stockpiling conducted at a mine site approximately six miles south-southwest of the EMF site. Due to the geographical separation from the EMF site, these emissions were not included in the air dispersion modeling. BAPCO's inventory also includes emissions from a road between the silica mine and the BAPCO facility. These road emissions were not included in the air dispersion modeling, due to the geographical separation from the facility, except for the portion of the silica haul road that traverses the FMC facility, which was included in the FMC emission inventory.

Recently, EPA provided a copy of the 1992 BAPCO SIP emission inventory to the Companies for comparison purposes. It was noted that this 1992 SIP inventory set emissions from silica crushing, mining and hauling sources at zero, which is similar to the adjustments made in this CERCLA inventory.

Bechtel personnel did not visit the BAPCO facility nor consult with BAPCO personnel in modifying and expanding the BAPCO emission inventory. The additional data incorporated into the inventory was not provided by BAPCO.

3.3.10 Comparison Between 1992 SIP Inventory and Additional Source Characterization Sources

The emission rates in the 1992 SIP inventory (as provided in EPA, 1995) were compared with the revised CERCLA inventory for those sources characterized by the Companies since 1993 (as described earlier in this section). The comparison was performed only for PM_{10}, since it is the only constituent common to the two inventories.

This comparison is shown on Table 3.3.10-1. Differences between the 1992 SIP emissions and the 1995 CERCLA emissions can be attributed to several distinct factors:

1. The 1992 SIP inventory was typically based on permitted emission levels, while the 1995 CERCLA inventory is based on normal-operation levels (Section 3.1.2.2). This factor

can account for differences between the inventories for the Simplot baghouses, cooling towers, scrubbers, coolers, and dryers.

2. Differences can also be attributed to use of site-specific source test data in the CERCLA RI inventory versus estimated emission calculations using typical source types (i.e., *AP-42* factors) reflected in the 1992 SIP inventory. This can be observed for furnace tapping fugitive emissions, slag pit, roads, slag pile, coke and ore handling, oversized ore, and calciner stacks.

3. Fugutive emissions from several Simplot roads and FMC's coke handling and oversized ore pile increased in the 1995 CERCLA inventory. This may be attributed to better review and characterization of these sources for the CERCLA effort versus the 1992 SIP inventory. The slag pit and furnace tapping fugitive emissions were lower in the 1995 CERCLA inventory.

4. Differences between inventories can also be attributed to the manner in which activities within a source have been combined. Activities conducted at the slag pit, gypsum stack, and ore-handling sources are described in slightly different ways in the two inventories. Further explanation is presented in Sections 3.1.2.1, 3.3.2, and 3.3.6.

In summary, this section illustrates the improvements achievable in source characterization through site-specific investigations. By basing the CERCLA inventory on normal-operation levels and by using site-specific source test data, the CERCLA inventory offers a realistic representation of typical emissions from the EMF facilities, compared with that offered in the 1992 SIP inventory, which significantly overstated emissions.

3.3.11 Emission Inventory Summaries

Summaries of the revised FMC, Simplot, and BAPCO emission inventories for the 1993-1994 period of study are presented in Tables 3.3.11-1, 3.3.11-2, and 3.3.11-3, respectively. Data are presented for typical daily and average annual emissions from point sources, point source fugitives, area sources, roads, and stockpiles. These data incorporate the results of the additional source characterizations with other emission characterization data (which are presented in Sections 3.4 through 3.7). The basis for calculation of the typical daily and average annual emissions was presented in Section 3.1.2.

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TABLE 3.3.1-1
FMC FURNACE #4 TAP HOOD VENT SOURCE TEST RESULTS

CONSTITUENT	AVERAGE METAL EMISSION RATE (lb/hr or µCi/hr)	AVERAGE SLAG EMISSION RATE (lb/hr or µCi/hr)	TIME-WEIGHTED AVERAGE OF METAL AND SLAG EMISSION RATES (lb/hr or µCi/hr)
Al	0.91	0.28	0.33
Sb	2.91E-02	7.78E-03	9.53E-03
As	2.71E-03	2.4E-03	2.43E-03
Ba	ND	ND	ND
Be	ND	ND	ND
Cd	0.27	1.88E-02	3.93E-02
Cr (total)	2.62E-02	1.32E-02	1.42E-02
Cu	1.26E-02	4.94E-03	5.56E-03
Fe	0.38	0.18	0.20
Pb	4.38E-02	1.18E-02	1.44E-02
Mn	9.85E-03	2.57E-03	3.17E-03
Ni	1.67E-02	4.86E-03	5.83E-03
Total P (ICAP)	2.83E-02	2.41E-02	2.44E-02
Se	1.58E-02	1.14E-02	1.17E-02
Ag	2.19E-02	7.25E-03	8.45E-03
Tl	3.30E-02	7.20E-03	9.31E-03
Zn	0.36	0.07	0.09
Hg	5.36E-03	6.29E-04	1.02E-03
Total Fluoride	1.98	0.91	1.00
P (IC)	7.12	4.01	4.26
Pb-210	2.96	0.60	0.79
PM_{10}	26.15	5.57	7.26
Po-210	0.85	0.35	0.39
SO_2	91.57	57.06	59.88
TSP, P_2O_5	40.68	24.30	25.64
TSP, metals	50.52	30.42	32.06
TSP, fluoride	50.86	23.67	25.90
TSP All	47.35	26.13	27.87

ND = Constituent not detected and emission rate established at zero.
ICAP = Inductively Coupled Argon Plasma
IC = Ion Chromatography

TABLE 3.3.1-2
FURNACE TAP HOOD FUGITIVE SOURCES

REVISED INVENTORY			1992 INVENTORY		
	Daily (lbs/day)	Annual Average (tons/yr)		Daily (lbs/day)	Annual Average (tons/yr)
PM_{10}	11.07	1.09	PM_{10}	1.77	0.28
TSP	42.50	4.19	TSP	3.34	0.54
Fluorides	1.52	0.15	Fluorides	0.29	0.05
	(g/s)	(g/s)		(g/s)	(g/s)
Sb	7.63E-05	4.12E-05	Sb	1.11E-06	9.83E-07
As	2.46E-05	1.82E-05	As	2.55E-06	2.25E-06
Be	ND	ND	Be	9.28E-09	8.19E-09
Cd	3.43E-04	2.12E-04	Cd	2.17E-05	1.92E-05
Total Cr	4.03E-04	4.96E-04	Cr	2.59E-06	2.29E-06
Pb	1.20E-04	6.85E-05	Pb	3.31E-06	2.92E-06
Ni	1.00E-04	1.06E-04	Ni	2.07E-07	1.83E-07
Total P	7.73E-03	1.14E-02	P_2O_5	NA	NA
Total Silica	NA	NA	Total Silica	NA	NA

ND = Constituent not detected and emission rate established at zero.
NA = Not analyzed.

TABLE 3.3.2-1
EMISSION FACTORS FOR THE HOT SLAG TAPPING OPERATION

ANALYTE	PM_{10} AVERAGE (lb/ton of slag]	TSP AVERAGE (lb/ton of slag)
Total Mass	1.51E-03	1.18E-02
Ag	9.28E-06	7.95E-07
Al	ND	ND
As	4.93E-07	6.76E-07
Ba	7.32E-05	4.42E-05
Br	1.54E-07	9.94E-07
Ca	ND	6.84E-06
Cd	ND	1.12E-05
Cl	ND	5.07E-07
Cr	5.32E-06	7.76E-06
Cu	6.36E-07	7.35E-07
Fe	6.44E-06	2.37E-05
Ga	ND	ND
Ge	9.21E-07	1.65E-07
Hg	5.48E-08	1.30E-07
In	1.26E-05	1.63E-05
K	2.17E-05	3.34E-05
La	1.53E-04	1.82E-04
Mn	2.92E-06	4.31E-06
Mo	1.04E-04	1.21E-04
Ni	1.69E-06	1.55E-06
P	ND	ND
Pb	1.03E-06	3.58E-07
Pd	4.95E-06	2.96E-06
Rb	1.09E-06	8.11E-07
S	5.13E-06	9.42E-07
Sb	3.04E-05	5.97E-06
Se	ND	6.15E-07
Sn	1.51E-05	9.98E-06
Sr	8.91E-07	4.78E-06
Ti	1.32E-07	0.00E+00
Tl	ND	ND
V	1.42E-07	ND
Y	1.10E-07	8.79E-07
Zn	ND	ND
Zr	3.35E-05	9.58E-06
Total F	-	1.60E-04
P_2O_5	4.02E-04	1.94E-04
Part.F	ND	ND
SO_4	1.91E-04	2.00E-04
Vapor F.	ND	
SO_2	6.75E-01	
Cr^{+6*}	5.32E-08	7.76E-08

(1) ND = Constituent not detected and emission factor established at zero.

(2) Cr^{+6} undetected in slag handling fugitive samples. Data are taken from related tap vent, slag and ferrophos samples.

TABLE 3.3.2-2
EMISSION FACTORS FOR THE SLAG QUENCHING

ANALYTE	PM_{10} AVERAGE (lb/ton of slag)	TSP AVERAGE (lb/ton of slag)
Total Mass	2.57E-02	9.62E-02
Ag	1.40E-07	1.59E-06
Al	9.64E-06	8.87E-06
As	2.01E-07	1.35E-06
Ba	3.71E-05	3.71E-05
Br	5.67E-06	1.40E-05
Ca	3.73E-05	3.79E-04
Cd	9.69E-06	9.69E-06
Cl	3.63E-05	5.59E-05
Cr	5.02E-06	6.51E-06
Cu	8.44E-07	8.44E-07
Fe	9.90E-06	5.60E-05
Ga	ND	6.37E-08
Ge	4.15E-07	7.85E-07
Hg	ND	1.53E-07
In	2.28E-07	1.29E-06
K	6.11E-04	8.56E-04
La	4.98E-05	3.79E-05
Mn	4.65E-06	4.65E-06
Mo	5.49E-05	6.44E-05
Ni	1.32E-06	1.32E-06
P	ND	ND
Pb	2.78E-06	2.78E-06
Pd	2.95E-06	4.54E-06
Rb	9.30E-06	2.14E-05
S	7.25E-06	2.06E-05
Sb	7.84E-06	7.02E-06
Se	1.17E-07	6.38E-07
Sn	7.29E-06	8.03E-06
Sr	4.56E-06	7.05E-06
Ti	9.90E-07	1.08E-06
Tl	ND	ND
V	ND	ND
Y	2.91E-08	7.69E-08
Zn	6.64E-05	1.31E-04
Zr	1.12E-05	1.12E-05
Total F	-	1.29E-03
P_2O_5	4.96E-03	4.96E-03
Part. F	ND	ND
Vapor F.	ND	
SO_4	9.56E-04	9.56E-04
Cr^{+6*}	5.02E-08	6.51E-08

(1) ND = Constituent not detected and emission factor established at zero.
(2) *Cr^{+6} undetected in slag handling fugitive samples. Data are taken from related tap vent, slag, and ferrophos samples.

TABLE 3.3.2-3
EMISSION FACTORS FOR THE HOT SLAG EXCAVATION OPERATION

ANALYTE	PM_{10} AVERAGE (lb/ton of slag)	TSP AVERAGE (lb/ton of slag)
Total Mass	1.08E-03	4.96E-03
Ag	1.50E-06	1.50E-06
Al	ND	ND
As	2.47E-07	5.19E-07
Ba	2.16E-06	4.01E-05
Br	1.97E-07	1.62E-07
Ca	1.88E-04	7.03E-04
Cd	3.13E-06	4.93E-06
Cl	8.04E-07	8.55E-07
Cr	3.81E-06	3.81E-06
Cu	4.88E-07	1.05E-06
Fe	9.06E-06	2.91E-05
Ga	ND	ND
Ge	3.51E-07	3.51E-07
Hg	ND	3.81E-09
In	4.24E-06	9.10E-06
K	1.77E-05	4.14E-05
La	1.19E-05	8.04E-05
Mn	2.86E-06	2.86E-06
Mo	4.88E-05	5.81E-05
Ni	1.02E-06	1.18E-06
P	ND	ND
Pb	1.21E-06	1.51E-06
Pd	1.17E-06	1.01E-06
Rb	1.15E-06	1.15E-06
S	6.49E-06	2.69E-05
Sb	3.79E-07	1.24E-06
Se	2.71E-07	2.71E-07
Sn	3.07E-06	3.35E-06
Sr	2.36E-06	2.97E-06
Ti	2.76E-07	1.90E-06
Tl	ND	ND
V	1.45E-08	ND
Y	1.79E-07	1.91E-08
Zn	1.08E-07	2.02E-06
Zr	4.67E-06	5.35E-06
Total F	-	6.76E-05
P_2O_5	2.53E-05	3.56E-05
Part. F	ND	ND
Vapor F.	ND	
SO_4	8.63E-05	1.23E-04
Cr^{+6*}	3.81E-08	3.81E-08

(1) ND = Constituent not detected and emission factor established at zero.
(2) *Cr^{+6} undetected in slag handling fugitive samples. Data are taken from related tap vent, slag, and ferrophos samples.

TABLE 3.3.2-4
EMISSION FACTORS FOR THE HOT SLAG LOADING OPERATION

ANALYTE	PM_{10} AVERAGE (lb/ton of slag)	TSP AVERAGE (lb/ton of slag)
Total Mass	9.44E-03	2.07E-02
Ag	1.44E-06	1.44E-06
Al	3.25E-06	5.22E-06
As	3.50E-07	4.07E-07
Ba	7.52E-06	9.36E-06
Br	1.46E-07	2.80E-07
Ca	1.68E-03	3.19E-03
Cd	1.40E-06	1.40E-06
Cl	6.88E-07	ND
Cr	5.67E-06	1.12E-05
Cu	5.69E-07	8.23E-07
Fe	4.10E-05	7.78E-05
Ga	ND	ND
Ge	1.73E-07	3.18E-07
Hg	2.24E-08	6.36E-08
In	4.94E-06	4.94E-06
K	8.18E-05	1.40E-04
La	1.04E-05	1.71E-05
Mn	2.60E-06	4.57E-06
Mo	1.47E-05	1.36E-05
Ni	1.30E-06	1.78E-06
P	ND	ND
Pb	1.39E-06	2.25E-06
Pd	4.91E-07	2.79E-07
Rb	8.51E-07	1.38E-06
S	4.63E-05	8.89E-05
Sb	1.02E-05	1.02E-05
Se	6.00E-08	2.75E-07
Sn	5.35E-06	5.35E-06
Sr	8.09E-06	1.54E-05
Ti	5.74E-06	1.26E-05
Tl	ND	1.32E-07
V	2.10E-07	4.54E-07
Y	8.78E-07	1.46E-06
Zn	8.81E-06	1.33E-05
Zr	3.57E-06	4.97E-06
Total F	-	2.70E-04
P_2O_5	5.11E-06	5.96E-06
Part. F	ND	ND
Vapor F.	ND	
SO_4	1.38E-04	2.45E-04
Cr^{+6}*	5.67E-08	1.12E-07

(1) ND = Constituent not detected and emission factor established at zero.
(2) *Cr^{+6} undetected in slag handling fugitive samples. Data are taken from related tap vent, slag, and ferrophos samples.

TABLE 3.3.2-5
EMISSION FACTORS FOR THE HOT SLAG DUMPING OPERATION

ANALYTE	PM_{10} AVERAGE (lb/ton of slag)	TSP AVERAGE (lb/ton of slag)
Total Mass	4.16E-02	1.38E-01
Ag	4.16E-07	1.69E-06
Al	1.52E-05	1.90E-05
As	8.67E-07	8.79E-07
Ba	7.08E-05	9.75E-05
Br	7.92E-07	1.88E-06
Ca	6.30E-03	7.80E-03
Cd	5.52E-06	5.52E-06
Cl	3.81E-06	6.86E-06
Cr	1.92E-05	4.95E-05
Cu	7.30E-07	1.95E-06
Fe	1.66E-04	3.09E-04
Ga	ND	ND
Ge	6.94E-07	6.60E-07
Hg	3.03E-08	ND
In	8.56E-06	3.82E-06
K	3.85E-04	4.67E-04
La	3.84E-05	6.00E-05
Mn	1.09E-05	1.37E-05
Mo	6.79E-05	8.30E-05
Ni	9.42E-07	8.82E-06
P	ND	ND
Pb	2.94E-06	6.35E-06
Pd	2.69E-06	7.22E-06
Rb	2.85E-06	3.51E-06
S	9.83E-05	1.62E-04
Sb	1.14E-05	1.58E-05
Se	7.98E-07	7.98E-07
Sn	1.19E-05	1.19E-05
Sr	2.47E-05	3.87E-05
Ti	2.77E-05	3.45E-05
Tl	ND	ND
V	3.91E-07	2.09E-06
Y	1.57E-06	5.65E-06
Zn	3.22E-05	3.65E-05
Zr	1.91E-05	1.91E-05
Total F	-	1.87E-3
P_2O_5	2.25E-04	2.25E-04
Part. F	ND	ND
Vapor F.	ND	
SO_4	3.52E-04	3.52E-04
Cr^{+6}*	1.92E-07	4.95E-07

(1) ND = Constituent not detected and emission factor established at zero.
(2) *Cr^{+6} undetected in slag handling fugitive samples. Data are taken from related tap vent, slag, and ferrophos samples.

TABLE 3.3.2-6
EMISSION FACTORS FOR THE COLD SLAG EXCAVATION OPERATION

ANALYTE	PM_{10} AVERAGE (lb/ton of slag)	TSP AVERAGE (lb/ton of slag)
Total Mass	1.99E-02	1.57
Ag	4.22E-07	1.43E-05
Al	ND	ND
As	1.82E-06	1.82E-06
Ba	1.02E-04	1.02E-04
Br	1.46E-06	1.46E-06
Ca	3.53E-03	7.66E-03
Cd	1.52E-05	1.52E-05
Cl	ND	1.03E-06
Cr	1.59E-05	2.57E-05
Cu	7.46E-07	5.57E-06
Fe	1.12E-04	2.00E-04
Ga	ND	ND
Ge	1.20E-06	1.20E-06
Hg	ND	ND
In	3.01E-06	1.08E-05
K	1.98E-04	3.85E-04
La	1.04E-04	4.20E-04
Mn	8.76E-06	1.95E-05
Mo	1.44E-04	1.59E-04
Ni	2.68E-06	5.63E-06
P	ND	ND
Pb	3.17E-06	3.17E-06
Pd	7.28E-06	7.28E-06
Rb	1.46E-06	1.46E-06
S	1.21E-04	2.64E-04
Sb	1.12E-05	3.80E-05
Se	2.34E-06	2.34E-06
Sn	ND	1.20E-05
Sr	1.87E-05	3.02E-05
Ti	1.39E-05	3.20E-05
Tl	ND	ND
V	ND	4.41E-06
Y	9.28E-07	2.67E-06
Zn	1.76E-05	1.76E-05
Zr	2.16E-05	2.16E-05
Total F	-	2.70E-4
P_2O_5	3.35E-04	3.35E-04
Part. F	ND	ND
Vapor F.	ND	
SO_4	4.49E-04	6.32E-04
Cr^{+6}*	1.59E-07	2.57E-07

(1) ND = Constituent not detected and emission factor established at zero.
(2) *Cr^{+6} undetected in slag handling fugitive samples. Data are taken from related tap vent, slag, and ferrophos samples.

TABLE 3.3.2-7
EMISSION FACTORS FOR THE COLD SLAG DUMPING OPERATIONS

RUN I.D.	PM_{10} AVERAGE (lb/ton of slag)	TSP AVERAGE (lb/ton of slag)
FMCH-1	3.39E-03	5.11E-03
FMCI-1*	5.20E-04	9.19E-04
FMCJ-1	1.89E-02	3.71E-02

* Only two valid filters for this run.

Table 3.3.2-8
Summary of Slag Pit Operation Emissions 1992 Inventory

	PM_{10}		TSP		Antimony		Arsenic		Beryllium		Cadmium	
	Daily (lb/day)	Annual (ton/yr)	Daily (lb/day)	Annual (ton/yr)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)
Slag Pit					4.165E-05	3.269E-05	9.58E-05	7.52E-05	3.47E-07	2.72E-07	8.12E-04	6.38E-04
Slag Quenching with Water	44.79	8.18	58.90	10.75								
Slag Digging	8.84	1.61	24.11	4.40								
Drop into Truck for Pile	8.84	1.61	24.11	4.40								
Dump Slag into Holding Pile	0.38	0.07	1.03	0.19								
Pick Up Slag from Holding Pile	0.38	0.07	1.03	0.19								
Truck Dump => Slag Pit	2.88	0.53	7.87	1.44								
Total	66.10	12.06	117.05	21.36	4.16E-05	3.27E-05	9.58E-05	7.52E-05	3.47E-07	2.72E-07	8.12E-04	6.38E-04

	Total Chromium		Total Fluoride		Lead		Nickel		P2O5		Total Silica	
	Daily (g/s)	Annual (g/s)	Daily (lb/day)	Annual (ton/yr)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)
Slag Pit	9.68E-05	7.60E-05	67.40	12.30	1.08E-05	8.45E-06	3.61E-05	2.83E-05			0.15	0.12
Slag Quenching with Water			2.02	0.37					1.18E-01	1.18E-01		
Slag Digging			0.36	6.60E-02					3.09E-02	3.09E-02		
Drop into Truck for Pile			0.36	6.60E-02					3.09E-02	3.09E-02		
Dump Slag into Holding Pile			0.34	2.82E-03					1.32E-03	1.32E-03		
Pick Up Slag from Holding Pile			0.34	2.82E-03					1.32E-03	1.32E-03		
Truck Dump => Slag Pit			0.12	2.15E-02					1.01E-02	1.01E-02		
Total	9.68E-05	7.60E-05	67.40	12.30	1.08E-05	8.45E-06	3.61E-05	2.83E-05	1.92E-01	1.92E-01	0.15	0.12

Shaded areas were not used in air dispersion modeling.

Table 3.3.2-9
Summary of Slag Pit Operation Emissions Revised Inventory

	PM_{10}		TSP		Antimony		Arsenic		Beryllium		Cadmium	
	Daily (lb/day)	Annual (ton/yr)	Daily (lb/day)	Annual (ton/yr)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)
Hot Slag Tapping	4.55	0.83	35.56	6.49	4.81E-04	4.81E-04	7.80E-06	7.80E-06	7.75E-09	7.75E-09	2.27E-05	2.27E-05
Slag Cooling w/water	77.45	14.14	289.92	52.91	1.24E-04	1.24E-04	3.18E-06	3.18E-06	1.32E-07	1.32E-07	1.53E-04	1.53E-04
Hot Slag Excavation	3.25	0.59	14.95	2.73	6.00E-06	6.00E-06	3.91E-06	3.91E-06	5.54E-09	5.54E-09	4.95E-05	4.95E-05
Hot Slag Loading	28.45	5.19	62.38	11.39	1.61E-04	1.61E-04	5.54E-06	5.54E-06	4.85E-08	4.85E-08	2.22E-05	2.22E-05
Cold Slag Dumping	6.80	1.24	12.89	2.35	0.00	0.00	9.20E-07	9.20E-07	1.16E-08	1.16E-08	1.08E-05	1.08E-05
Total	120.50	21.99	415.66	75.86	7.72E-04	7.72E-04	2.13E-05	2.13E-05	2.05E-07	2.05E-07	2.58E-04	2.58E-04

	Total Chromium		Total Fluoride		Lead		Nickel		Total Phosphorus		Total Silica	
	Daily (g/s)	Annual (g/s)	Daily (lb/day)	Annual (ton/yr)	Daily (g/s)	Annual (g/s)	Daily (g/s)	Annual (g/s)	Daily (lb/day)	Annual (ton/yr)	Daily (g/s)	Annual (g/s)
Hot Slag Tapping	8.42E-05	8.42E-05	0.48	0.09	1.63E-05	1.63E-05	2.67E-05	2.67E-05	2.78E-03	2.78E-03	0.00	0.00
Slag Cooling w/IWW	7.94E-05	7.94E-05	3.89	0.71	4.40E-05	4.40E-05	2.09E-05	2.09E-05	3.43E-02	3.43E-02	0.00	0.00
Hot Slag Excavation	6.03E-05	6.03E-05	0.20	0.04	1.91E-05	1.91E-05	1.61E-05	1.61E-05	1.75E-04	1.75E-04	0.00	0.00
Hot Slag Loading	8.97E-05	8.97E-05	0.81	0.15	2.20E-05	2.20E-05	2.06E-05	2.06E-05	1.53E-03	1.53E-03	0.00	0.00
Cold Slag Dumping	2.23E-05	2.23E-05	1.67	0.31	3.80E-06	3.80E-06	7.97E-06	7.97E-06	7.46E-04	7.46E-04	7.29E-03	7.29E-03
Total	3.36E-04	3.36E-04	7.07	1.29	1.05E-04	1.05E-04	9.23E-05	9.23E-05	3.95E-02	3.95E-02	7.29E-03	7.29E-03

TABLE 3.3.3-1
FMC SITE ROAD DESCRIPTIONS

ROAD/SITE DESCRIPTION	ROAD NUMBER	ROAD TYPE	NUMBER OF SAMPLES	XRF†	Cr VI‡
Slag Road to BAPCO Pile	F11	Paved	3	*	
Entrance	F17	Paved	1	*	*
Slag Road	F17	Paved	3	*	*
East of Main Plant	F21	Paved	3	*	*
Slag Pile	FSC	Unpaved	10	*	
Silica Haul Road	F02	Unpaved	3	*	
Middle Slag Pile Road	F03	Unpaved	3	*	
West Slag Pile Road	F04	Unpaved	3	*	
West of Slag Pile to Kinport Road	F05	Unpaved	3	*	*
Road South of Ore Pile	F22	Unpaved	3	*	*
East Site Boundary	F23	Unpaved	3	*	
North of East Slag Pile	F26	Unpaved	3	*	

†XRF - X-ray fluorescence analysis
‡Cr^{+6} - Hexavalent chromium analysis

TABLE 3.3.3-2
MODELED SOURCE NAMES AND ASSOCIATED INVENTORY ROADS

ROADS CENTERED ON SLAG PIT	TYPE OF ROAD	ROADS CENTERED ON POND AREA	TYPE OF ROAD
17	Paved	8	Paved
18A	Paved	11	Paved
19	Paved	5	Unpaved to Paved
20	Paved	6	Unpaved to Paved
21	Paved	7	Unpaved
25	Paved	9	Unpaved
28	Unpaved to Paved	10	Unpaved
32	Paved	12	Unpaved
26	Unpaved to Paved	13	Unpaved
27	Unpaved	14	Unpaved
30	Unpaved	15	Unpaved
31	Unpaved	16	Unpaved
		29	Unpaved
ROADS CENTERED ON SLAG PILE	**TYPE OF ROAD**	**ROADS CENTERED ON ORE**	**TYPE OF ROAD**
1	Unpaved	18	Unpaved to Paved
2	Unpaved to Paved	22	Unpaved
3	Unpaved	23	Unpaved to Paved
4	Unpaved to Paved	24	Unpaved to Paved

TABLE 3.3.3-3
EMISSION SUMMARY FOR FMC ROADS

ROADS CENTERED ON SLAG PIT					
Revised Inventory			**1992 Inventory**		
	Daily (lbs/day)	**Average Annual (tons/yr)**		**Daily (lbs/day)**	**Average Annual (tons/yr)**
PM_{10}	49.21	6.84	PM_{10}	149.30	20.90
TSP	20.32	2.73	TSP	174.39	20.13
Fluorides	0.27	0.04	Fluorides	NA	NA
	(g/s)	**(g/s)**		**(g/s)**	**(g/s)**
Sb	ND	ND	Sb	2.51E-05	1.92E-05
As	ND	ND	As	4.62E-05	3.55E-05
Be	8.38E-08	6.38E-08	Be	7.84E-07	6.01E-07
Cd	6.43E-05	4.90E-05	Cd	3.29E-03	2.53E-03
Cr (total)	2.05E-04	1.56E-04	Cr (total)	1.85E-03	1.42E-03
Pb	1.70E-05	1.29E-05	Pb	4.64E-04	3.56E-04
Ni	4.13E-05	3.14E-05	Ni	2.41E-04	1.85E-04
Total P	5.00E-03	3.80E-03	Total P	NA	NA
Total Silica	3.74E-02	2.85E-02	Total Silica	NA	NA

TABLE 3.3.3-3 *(continued)*
EMISSION SUMMARY FOR FMC ROADS

ROADS CENTERED ON POND AREA					
Revised Inventory			1992 Inventory		
	Daily (lbs/day)	Average Annual (tons/yr)		Daily (lbs/day)	Average Annual (tons/yr)
PM_{10}	83.59	9.19	PM_{10}	77.14	10.80
TSP	160.67	16.88	TSP	119.23	16.69
Fluorides	3.36	0.35	Fluorides	NA	NA
	(g/s)	(g/s)		(g/s)	(g/s)
Sb	ND	ND	Sb	1.21E-06	9.32E-07
As	ND	ND	As	2.83E-06	2.17E-06
Be	1.42E-07	8.58E-08	Be	4.05E-07	3.11E-06
Cd	6.67E-05	4.02E-05	Cd	1.34E-03	1.03E-03
Cr (total)	2.76E-04	1.66E-04	Cr (total)	2.39E-04	1.83E-04
Pb	3.34E-05	2.01E-05	Pb	1.82E-04	1.40E-04
Ni	4.87E-05	2.93E-05	Ni	4.58E-05	3.51E-05
Total P	5.28E-03	3.18E-03	Total P	NA	NA
Total Silica	7.77E-02	4.68E-02	Total Silica	NA	NA

ND = Constituent not detected and emission factor established at zero.
NA = Not analyzed.

ROADS CENTERED ON SLAG PILE					
Revised Inventory			1992 Inventory		
	Daily (lbs/day)	Average Annual (tons/yr)		Daily (lbs/day)	Average Annual (tons/yr)
PM_{10}	165.10	18.64	PM_{10}	253.75	35.50
TSP	280.83	29.30	TSP	563.88	78.94
Fluorides	5.87	0.61	Fluorides	NA	NA
	(g/s)	(g/s)		(g/s)	(g/s)
Sb	ND	ND	Sb	4.00E-06	3.06E-06
As	3.55E-05	2.20E-05	As	9.33E-06	7.15E-06
Be	2.81E-07	1.74E-07	Be	1.33E-06	1.02E-06
Cd	1.33E-04	8.27E-05	Cd	4.40E-03	3.37E-03
Cr (total)	4.40E-04	2.73E-04	Cr (total)	7.85E-04	6.02E-04
Pb	4.42E-05	2.74E-05	Pb	5.99E-04	4.60E-04
Ni	8.23E-05	5.10E-05	Ni	1.51E-04	1.15E-05
Total P	1.01E-02	6.27E-03	Total P	NA	NA
Total Silica	1.48E-01	9.15E-02	Total Silica	NA	NA

TABLE 3.3.3-3 *(continued)*
EMISSION SUMMARY FOR FMC ROADS

ROADS CENTERED ON ORE					
Revised Inventory			**1992 Inventory**		
	Daily (lbs/day)	**Average Annual (tons/yr)**		**Daily (lbs/day)**	**Average Annual (tons/yr)**
PM_{10}	62.27	6.47	PM_{10}	67.12	9.40
TSP	135.97	14.04	TSP	149.17	20.17
Fluorides	2.94	0.30	Fluorides	NA	NA
	(g/s)	**(g/s)**		**(g/s)**	**(g/s)**
Sb	ND	ND	Sb	1.06E-06	8.11E-07
As	1.11E-05	6.33E-06	As	2.47E-06	1.89E-06
Be	1.06E-07	6.04E-08	Be	3.52E-07	2.70E-07
Cd	3.33E-05	1.90E-05	Cd	1.16E-03	8.98E-04
Cr (total)	3.25E-04	1.85E-04	Cr (total)	2.08E-04	1.59E-04
Pb	3.30E-05	1.88E-05	Pb	1.59E-04	1.22E-04
Ni	6.42E-05	3.66E-05	Ni	3.98E-05	3.06E-05
Total P	5.97E-03	3.40E-03	Total P	NA	NA
Total Silica	5.49E-02	3.13E-02	Total Silica	NA	NA

ND = Constituent not detected and emission factor established at zero.
NA = Not analyzed.

TABLE 3.3.3-4
SUMMARY OF ALL FMC ROAD EMISSION RATES

REVISED INVENTORY			1992 INVENTORY		
	Daily (lbs/day)	Annual Average (tons/yr)		Daily (lbs/day)	Annual Average (tons/yr)
PM_{10}	360.17	41.17	PM_{10}	547.31	76.6
TSP	597.78	62.95	TSP	1006.67	135.93
Fluorides	9.51	1.31	Fluorides	NA	NA
	(g/s)	(g/s)		(g/s)	(g/s)
Sb	ND	ND	Sb	3.14E-05	2.40E-05
As	4.67E-05	2.84E-05	As	6.08E-05	4.48E-05
Be	6.14E-07	3.84E-07	Be	2.87E-06	4.06E-06
Cd	2.98E-04	1.91E-04	Cd	1.02E-02	7.83E-03
Cr (total)	1.25E-03	7.80E-04	Cr (total)	3.08E-03	4.68E-03
Pb	1.28E-04	7.92E-05	Pb	1.40E-03	1.08E-03
Ni	2.37E-04	1.48E-04	Ni	4.78E-04	2.62E-04
Total P	2.64E-02	1.67E-02	Total P	NA	NA
Total Silica	3.18E-01	1.98E-01	Total Silica	NA	NA

ND = Constituent not detected and emission factor established at zero. NA = Not analyzed.

TABLE 3.3.4-1
SUMMARY OF SLAG PILE SOURCE EMISSIONS

REVISED INVENTORY			1992 INVENTORY		
	Daily (lbs/day)	Average Annual (tons/yr)		Daily (lbs/day)	Average Annual (tons/yr)
PM_{10}	150.10	27.06	PM_{10}	851.00	104.67
TSP	468.67	84.86	TSP	1783.04	218.62
Fluoride	6.17	1.11	Fluoride	44.58	1.08
	(g/s)	(g/s)		(g/s)	(g/s)
Sb	ND	ND	Sb	NA	NA
As	2.03E-05	2.01E-05	As	6.25E-05	4.22E-05
Be	2.56E-07	2.53E-07	Be	4.47E-06	3.01E-06
Cd	2.39E-04	2.36E-04	Cd	1.97E-03	1.33E-03
Cr (total)	4.92E-04	4.86E-04	Cr (total)	2.09E-03	1.41E-03
Pb	8.40E-05	8.30E-05	Pb	1.39E-04	9.34E-05
Ni	1.76E-04	1.74E-04	Ni	4.47E-06	3.01E-06
Total P	1.65E-02	1.63E-02	Total P	NA	NA
Total Silica	1.61E-01	1.59E-01	Total Silica	1.97	1.33

ND = Constituent not detected and emission factor established at zero.
NA = Not analyzed.

TABLE 3.3.5-1
SIMPLOT GRANULATION #2 BAGHOUSE
Method 5 Particulate Filter Analysis - 300 Minute Stack Sample Period

ANALYTE	DAILY EMISSIONS (lbs/hr)	ANALYTE	DAILY EMISSIONS (lbs/hr)	ANALYTE	DAILY EMISSIONS (lbs/hr)
Aluminum	9.41E-04	Magnesium	8.35E-04	Tellurium	ND
Arsenic	ND	Manganese	2.47E-05	Thallium	ND
Barium	ND	Molybdenum	ND	Titanium	ND
Beryllium	ND	Nickel	1.13E-03	Tungsten	ND
Calcium	4.18E-03	Lead	ND	Vanadium	1.53E-04
Cadmium	2.94E-05	Phosphorus	2.82E-02	Yttrium	2.00E-05
Cobalt	ND	Platinum	ND	Zinc	9.98E-04
Chromium	6.00E-05	Selenium	ND	Zirconium	ND
Copper	1.41E-05	Silver	ND	PM_{10}	0.54
Iron	9.76E-04	Sodium	ND	TSP	0.54
Lithium	4.71E-06	Tin	5.88E-05	Fluoride	0.02

ND = Constituent not detected and emission factor established at zero.

TABLE 3.3.5-2
SUMMARY OF GRANULATION #2 BAGHOUSE SOURCE EMISSIONS

REVISED INVENTORY			1992 INVENTORY		
	Daily (lbs/day)	Average Annual (tons/yr)		Daily (lbs/day)	Average Annual (tons/yr)
PM_{10}	10.63	1.39	PM_{10}	2.76	0.26
TSP	12.96	1.69	TSP	3.36	0.32
Fluoride	0.48	0.06	Fluoride	2.04	0.19
	(g/s)	(g/s)		(g/s)	(g/s)
Sb	ND	ND	Sb	0	0
As	ND	ND	As	4.1 E-07	2.1 E-07
Be	ND	ND	Be	1.4 E-08	7.5 E-09
Cd	3.3E-06	2.3E-06	Cd	1.9 E-07	9.8 E-08
Cr	6.69E-06	4.79E-06	Cr	9.9 E-07	5.2 E-07
Pb	ND	ND	Pb	0	0
Ni	5.20E-06	3.8E-06	Ni	5.2 E-07	2.7 E-07
Total Silica	ND	ND	Total Silica	0	0
Total P	3.15E-03	2.25E-03	Total P	0	0

ND = Constituent not detected and emission factor established at zero.
NA = Not analyzed.

TABLE 3.3.6-1
SIMPLOT GYPSUM STACK SLURRY RESULTS–SOLIDS

CHEMICAL NAME	CONCENTRATION (mg/kg)	CHEMICAL NAME	CONCENTRATION (mg/kg)
Aluminum	1180	Magnesium	213
Antimony	3.8	Manganese	1.9
Arsenic	0.72	Mercury	0.38
Barium	39.7	Molybdenum	5.3
Beryllium	0.23	Nickel	25.5
Boron	14	Phosphorus, total	6560
Cadmium	34.8	Potassium	1300
Calcium	233000	Selenium	15.6
Chromium (total)	110	Silver	7.3
Cobalt	0.39	Sodium	2090
Copper	38.6	Sulfate	540000
Fluoride	6900	Thallium	0.64
Iron	480	Vanadium	190
Lead	5.4	Zinc	211
Lithium	0.39		

TABLE 3.3.6-2
SUMMARY OF GYPSUM STACK EMISSIONS

REVISED INVENTORY			1992 INVENTORY		
	Daily (lb/day)	Average Annual (ton/yr)		Daily (lb/day)	Average Annual (ton/yr)
PM_{10}	110.96	7.90	PM_{10}	103.31	7.35
TSP	232.5	16.38	TSP	216.71	15.26
Fluoride	1.60	0.10	Fluoride	6.08	1.00
	(g/s)	(g/s)		(g/s)	(g/s)
Sb	4.64E-06	1.76E-06	Sb	0	0
As	8.76E-07	3.39E-07	As	8.13E-06	3.86E-05
Be	2.81E-07	1.08E-07	Be	5.42E-07	2.58E-06
Cd	4.25E-05	1.64E-05	Cd	9.22E-05	4.38E-04
Cr (total)	1.34E-04	5.18E-05	Cr	7.16E-04	3.40E-03
Pb	6.59E-06	2.54E-06	Pb	6.35E-05	3.01E-04
Ni	3.11E-05	1.20E-05	Ni	1.08E-04	5.15E-04
Total Silica	NA	NA	Total Silica	0	0
Total P	8.01E-03	3.09E-03	Total P	0	0

NA = Not analyzed

TABLE 3.3.7-1
ROAD DESCRIPTION AND SAMPLING APPROACH

ROAD/SITE DESCRIPTION	ROAD NO.	ROAD TYPE	NUMBER OF SAMPLES	XRF†	Cr VI‡
N/S Intersection to Main Bldg.	S01	Paved	3	*	*
Main Gate to East of TSP Bldg.	S02	Paved	3	*	*

†XRF - X-ray fluorence analysis
‡Cr^{+6} - Hexavalent chromium analysis

TABLE 3.3.7-2
MODEL SOURCE NAMES AND ASSOCIATED INVENTORY ROADS

1992 SIMPLOT MODELED ROADS

Roads Centered on Ammonium Phosphate	Type of Road
Main Gate => GRI	Paved
GRI => NSI	Paved
NSI => Ammo2 load	Paved
NSI => Ammo1 load	Paved
NSI => Ammo SO4	Paved
Ammo2 load => Main Gate	Paved
Ammo1 load => Main Gate	Paved
Ammo SO4 => Main Gate	Paved

Roads Centered on Triple Super Phosphate	Type of Road
Main Gate => Triple	Paved
Triple => Main Gate	Paved
GRI-GRI W	Paved
GRI S-EWI	Paved

REVISED SIMPLOT MODELED ROADS

TSP Road	**Type of Road**
Main Gate => GRI	Paved
Main Gate => Triple	Paved
Triple => Main Gate	Paved
All other plant traffic on segment	Paved
Granulation Road	**Type of Road**
Ammo2 load => Main Gate	Paved
Ammo1 load => Main Gate	Paved
Ammo SO_4 => Main Gate	Paved
All other plant traffic on segment	Paved

Sulfuric Road	**Type of Road**
NSI => Ammo2 load	Paved
NSI => Ammo1 load	Paved
NSI => Ammo SO_4	Paved
All other plant traffic on segment	Paved
AIRCO Road	**Type of Road**
Airco Trucks Entering	Paved
Airco Trucks Leaving	Paved
All other plant traffic on segment	Paved
Cooling Road	**Type of Road**
GRI => NSI	Paved
All other plant traffic on segment	Paved

TABLE 3.3.7-3
EMISSION SUMMARY FOR SIMPLOT PAVED ROADS

REVISED INVENTORY			1992 INVENTORY		
	Daily lbs/day)	Average Annual (tons/yr)		Daily (lbs/day)	Average Annual (tons/yr)
PM_{10}	34.98	1.94	PM_{10}	20.68	1.58
TSP	12.83	0.72	TSP	26.32	2.01
Fluorides	ND	ND	Fluorides	0	0
	(g/s)	(g/s)		(g/s)	(g/s)
Sb	1.27E-06	3.21E-07	Sb	8.19E-07	4.21E-07
As	7.47E-06	1.88E-06	As	1.45E-05	1.05E-05
Be	ND	ND	Be	1.98E-07	1.31E-07
Cd	4.37E-05	1.10E-05	Cd	5.51E-05	3.69E-05
Cr (total)	4.31E-04	1.14E-04	Cr (total)	2.41E-04	12.18E-05
Pb	1.64E-05	4.77E-06	Pb	2.30E-05	1.79E-05
Ni	9.40E-05	2.54E-05	Ni	7.78E-05	5.19E-05
Total Phosphorus	2.18E-02	5.81E-03	Total Phosphorus	0	0
Total Silica	3.37E-02	9.79E-03	Total Silica	0	0

ND = Constituent not detected and emission factor established at zero.

Table 3.3.10-1
Comparison of 1992 SIP Inventory with Additional Source Characterization Sources

Source	1992 SIP		1995 CERCLA	
	Daily (lb/day)	Annual (ton/yr)	Daily (lb/day)	Annual (ton/yr)
Furnace Tapping Fugitives	2620	410	11	1.1
Slag Pit	3211	566	121	22
FMC Roads	561	79	360	41
Simplot Roads	38	2.7	65	3.3
Slag Pile	851	105	150	27
Granulation #2 Baghouse	181	17	11	1.4
Gyp Stack	103	7.3	111	7.9
Coke Handling	2.32	0.27	232	43
Ore Handling	82.3	7.5	86	11.1
Calciner Stacks	961	137	724	99
Oversized Ore	43	2.4	370	50
Granulation #1 Dryer	337	42	57	8.5
Granulation #3 Scrubber	206	20	63	7.0
Reclaim Cooling Towers	678	112	139	24
Ammonium Sulfate Dryer	20	3.1	19	3.0
Ammonium Sulfate Cooler	79	12	4.6	0.8

Table 3.3.11-1
Summary of FMC Emissions

	PM_{10}		TSP		Antimony		Arsenic		Beryllium	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	1,654.38	190.99	2,725.03	321.49	0.10	8.95E-03	1.10E-01	9.36E-03	8.83E-04	1.23E-04
Point Fugitives:	504.76	78.62	1,286.53	203.60	1.75E-02	1.96E-03	3.69E-02	5.80E-03	1.16E-04	1.79E-05
Area Sources:	366.58	67.80	979.06	180.64	0.15	2.69E-02	5.82E-03	1.02E-03	1.06E-04	1.92E-05
Roads:	360.17	41.17	597.78	62.95	0.00	0.00	8.89E-03	9.86E-04	1.17E-04	1.34E-05
Stockpiles:	642.93	87.82	1,456.16	206.47	1.62E-05	1.12E-05	2.66E-02	3.49E-03	2.09E-04	2.86E-05
Total Plant:	3,528.83	466.39	7,044.56	975.15	0.26	3.78E-02	1.88E-01	2.07E-02	1.43E-03	2.02E-04

	Cadmium		Total Chromium		Fluoride		Lead		Nickel	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	2.05	0.19	1.52	2.22E-01	93.23	12.20	0.19	2.05E-02	0.33	4.71E-02
Point Fugitives:	0.15	1.88E-02	0.90	1.34E-01	41.53	5.99	3.44E-02	4.05E-03	0.17	2.52E-02
Area Sources:	5.22E-02	9.43E-03	0.21	3.48E-02	19.77	3.63	2.36E-02	4.29E-03	0.06	1.01E-02
Roads:	5.67E-02	6.63E-03	0.24	2.71E-02	12.44	1.31	2.43E-02	2.75E-03	0.05	5.16E-03
Stockpiles:	0.15	2.04E-02	1.48	0.19	26.36	3.63	0.03	4.10E-03	0.26	3.44E-02
Total Plant:	2.45	0.25	4.34	0.61	193.33	26.76	0.30	3.57E-02	0.87	0.12

	Total Phosphorus		Total Silica		Pb-210		Po-210		Ra-226	
	lb/day	tons/yr	lb/day	tons/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	158.06	16.42	93.30	14.71	1.01E-05	2.87E-03	1.57E-02	4.29	1.37E-05	3.87E-03
Point Fugitives:	66.91	11.16	60.66	9.65	3.83E-06	1.08E-03	4.39E-06	1.43E-03	3.72E-06	1.15E-03
Area Sources:	9.95	1.75	13.95	2.39	8.11E-06	2.96E-03	4.70E-06	1.66E-03	1.55E-06	5.43E-04
Roads:	5.02	0.58	60.50	6.88	ND	ND	ND	ND	ND	ND
Stockpiles:	36.94	4.73	112.77	15.65	9.49E-06	3.03E-03	1.80E-05	5.18E-03	7.13E-06	1.94E-03
Total Plant:	276.89	34.64	341.18	49.28	3.16E-05	9.93E-03	1.57E-02	4.30	2.60E-05	7.50E-03

	Ra-228		Th-230		Th-232		U-234		U-235		U-238	
	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	5.46E-07	1.56E-04	1.21E-05	3.44E-03	3.84E-07	1.12E-04	1.25E-05	3.54E-03	5.36E-07	1.53E-04	1.26E-05	3.55E-03
Point Fugitives:	1.57E-07	4.74E-05	3.15E-06	9.68E-04	1.58E-07	4.77E-05	3.35E-06	1.02E-03	1.45E-07	4.44E-05	3.16E-06	9.64E-04
Area Sources:	2.09E-07	7.56E-05	1.08E-06	3.78E-04	2.10E-07	7.62E-05	1.12E-06	3.93E-04	4.92E-08	1.73E-05	1.06E-06	3.72E-04
Roads:	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Stockpiles:	4.17E-07	1.30E-04	5.41E-06	1.44E-03	4.20E-07	1.30E-04	5.14E-06	1.36E-03	2.25E-07	5.96E-05	4.86E-06	1.29E-03
Total Plant:	1.33E-06	4.09E-04	2.18E-05	6.23E-03	1.17E-06	3.67E-04	2.21E-05	6.31E-03	9.56E-07	2.74E-04	2.16E-05	6.17E-03

ND - No data for estimating.

Table 3.3.11-2
Summary of JRS Emissions

	PM_{10}		TSP		Antimony		Arsenic		Beryllium	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	816.10	130.84	1,439.50	234.78	9.99E-04	1.82E-04	1.06E-02	1.93E-03	0.00	0.00
Point Fugitives:	80.23	11.25	97.83	13.72	0.00	0.00	0.00	0.00	0.00	0.00
Area Sources:	30.24	4.14	201.60	27.61	0.00	0.00	0.00	0.00	0.00	0.00
Roads:	65.25	3.34	80.09	3.81	2.42E-04	1.12E-05	1.42E-03	6.55E-05	0.00	0.00
Stockpiles:	110.96	7.90	232.50	16.38	8.83E-04	6.22E-05	1.67E-04	1.18E-05	5.35E-05	3.77E-06
Total Plant:	1,102.78	157.47	2,051.51	296.30	2.12E-03	2.56E-04	1.22E-02	2.01E-03	5.35E-05	3.77E-06

	Cadmium		Total Chromium		Fluoride		Lead		Nickel	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	6.57E-02	1.17E-02	6.32E-01	1.15E-01	934.80	151.98	9.40E-03	1.72E-03	1.55E-01	2.77E-02
Point Fugitives:	1.29E-02	1.88E-03	2.07E-03	2.70E-04	13.85	1.50	0.00	0.00	1.93E-03	2.45E-04
Area Sources:	2.40E-03	3.38E-04	9.07E-04	1.18E-04	3.10	0.40	0.00	0.00	9.84E-04	1.23E-04
Roads:	8.32E-03	3.83E-04	8.20E-02	3.98E-03	ND	ND	3.12E-03	1.66E-04	1.79E-02	8.84E-04
Stockpiles:	8.09E-03	5.70E-04	2.56E-02	1.80E-03	7.68	1.21	1.26E-03	8.84E-05	5.93E-03	4.18E-04
Total Plant:	0.10	1.48E-02	0.74	0.12	959.43	155.09	1.38E-02	1.97E-03	0.18	2.94E-02

	Total Phosphorus		Total Silica		Pb-210		Po-210		Ra-226	
	lb/day	tons/yr	lb/day	tons/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	48.50	7.85	11.02	2.01	1.68E-06	5.85E-04	7.32E-06	2.56E-03	8.70E-06	3.03E-03
Point Fugitives:	3.41	0.47	0.00	0.00	4.43E-08	1.15E-05	2.00E-07	5.32E-05	8.29E-08	2.01E-05
Area Sources:	1.08	0.14	0.00	0.00	2.57E-08	6.51E-06	8.91E-08	2.12E-05	5.69E-08	1.29E-05
Roads:	4.16	0.20	6.42	0.34	ND	ND	ND	ND	ND	ND
Stockpiles:	1.53	0.11	ND	ND	5.54E-08	7.88E-06	1.31E-06	1.86E-04	1.16E-06	1.65E-04
Total Plant:	58.67	8.77	17.44	2.35	1.81E-06	6.11E-04	8.92E-06	2.82E-03	9.99E-06	3.23E-03

	Ra-228		Th-230		Th-232		U-234		U-235		U-238	
	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	5.05E-08	1.32E-05	1.35E-05	4.51E-03	1.34E-07	4.38E-05	1.08E-05	3.68E-03	2.21E-07	7.83E-05	8.13E-06	2.66E-03
Point Fugitives:	1.41E-08	3.68E-06	1.78E-06	5.08E-04	4.85E-08	1.43E-05	3.41E-07	8.16E-05	5.95E-09	1.55E-06	9.91E-07	2.74E-04
Area Sources:	6.17E-09	1.61E-06	4.36E-07	1.13E-04	7.13E-09	2.10E-06	2.34E-07	5.44E-05	2.61E-09	6.80E-07	3.26E-07	8.19E-05
Roads:	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Stockpiles:	0.00	0.00	1.31E-06	1.86E-04	0.00	0.00	1.21E-06	1.72E-04	0.00	0.00	0.00	0.00
Total Plant:	7.07E-08	1.85E-05	1.70E-05	5.32E-03	1.90E-07	6.03E-05	1.25E-05	3.99E-03	2.30E-07	8.05E-05	9.44E-06	3.01E-03

ND - No data for estimating.

Table 3.3.11-3
Summary of BAPCO Emissions

	PM_{10}		TSP		Antimony		Arsenic		Beryllium	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	10.85	0.56	13.45	0.67	0.00	0.00	1.11E-05	2.03E-07	4.51E-07	8.25E-09
Point Fugitives:	66.08	3.53	198.32	10.75	0.00	0.00	3.70E-05	6.66E-07	1.51E-06	2.71E-08
Area Sources:	1,054.32	44.49	2,287.32	97.67	2.35E-01	1.38E-02	3.89E-02	2.33E-03	1.65E-04	1.17E-05
Roads:	153.96	13.04	304.98	25.06	0.00	0.00	0.00	0.00	5.00E-05	4.23E-06
Stockpiles:	59.06	4.96	123.74	10.31	2.31E-02	1.94E-03	3.90E-03	3.27E-04	1.90E-05	1.59E-06
Total Plant:	1,344.28	66.58	2,927.81	144.46	2.58E-01	1.57E-02	4.29E-02	2.66E-03	2.36E-04	1.76E-05

	Cadmium		Total Chromium		Fluoride		Lead		Nickel	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	0.00	0.00	3.04E-04	5.56E-06	ND	ND	2.84E-05	5.19E-07	1.57E-04	2.88E-06
Point Fugitives:	0.00	0.00	1.02E-03	1.83E-05	ND	ND	9.49E-05	1.71E-06	5.25E-04	9.44E-06
Area Sources:	3.19E-01	1.87E-02	3.54E-01	2.21E-02	19.06	1.12	6.84E-02	4.14E-03	6.64E-02	4.61E-03
Roads:	5.44E-03	5.71E-04	1.15E-01	9.40E-03	6.35	0.52	2.73E-03	2.87E-04	1.92E-02	1.59E-03
Stockpiles:	3.14E-02	2.63E-03	3.67E-02	3.07E-03	1.80	0.15	6.90E-03	5.78E-04	7.52E-03	6.28E-04
Total Plant:	3.56E-01	2.19E-02	5.06E-01	3.46E-02	27.20	1.79	7.82E-02	5.01E-03	9.38E-02	6.84E-03

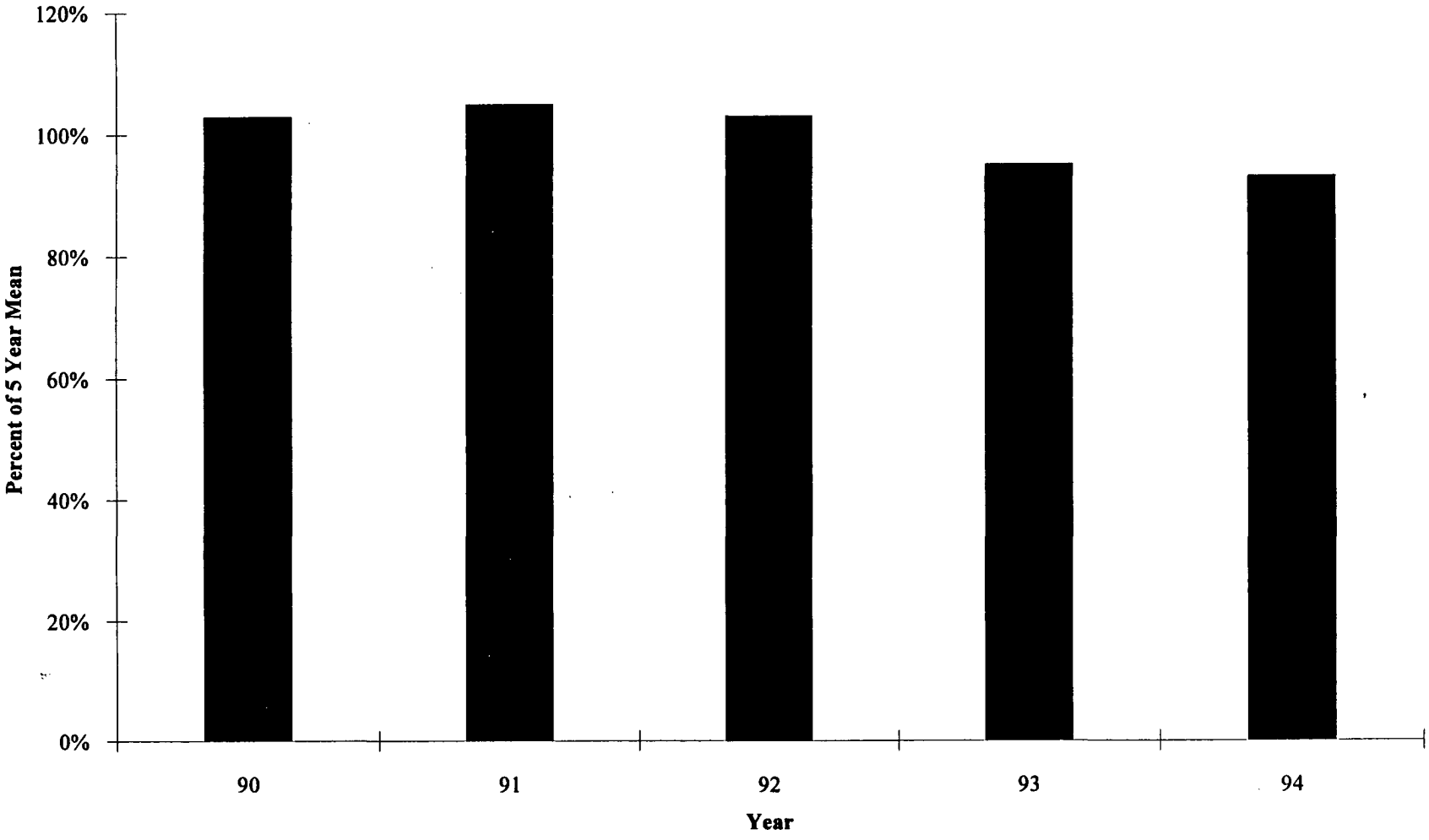
	Total Phosphorus		Total Silica		Pb-210		Po-210		Ra-226	
	lb/day	tons/yr	lb/day	tons/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	1.77E-03	3.23E-05	2.47E-02	4.52E-04	1.17E-09	4.29E-08	6.35E-10	2.32E-08	3.91E-10	1.43E-08
Point Fugitives:	5.90E-03	1.06E-04	8.26E-02	1.49E-03	3.92E-09	1.41E-07	2.12E-09	7.63E-08	1.31E-09	4.69E-08
Area Sources:	8.85	0.53	86.93	5.21	1.76E-05	2.23E-03	1.34E-05	1.58E-03	4.23E-06	4.96E-04
Roads:	1.89	0.16	26.55	2.26	6.04E-06	1.02E-03	4.95E-06	8.39E-04	1.56E-06	2.64E-04
Stockpiles:	0.88	0.07	8.70	0.73	1.62E-06	2.73E-04	1.33E-06	2.23E-04	4.20E-07	7.05E-05
Total Plant:	11.64	0.76	122.28	8.21	2.52E-05	3.52E-03	1.97E-05	2.64E-03	6.21E-06	8.30E-04

	Ra-228		Th-230		Th-232		U-234		U-235		U-238	
	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	0.00	0.00	9.77E-11	3.57E-09	0.00	0.00	1.13E-09	4.15E-08	4.96E-11	1.81E-09	1.07E-09	3.91E-08
Point Fugitives:	0.00	0.00	3.26E-10	1.17E-08	0.00	0.00	3.79E-09	1.36E-07	1.66E-10	5.96E-09	3.57E-09	1.28E-07
Area Sources:	6.92E-07	8.12E-05	2.58E-06	3.03E-04	6.92E-07	8.12E-05	2.63E-06	3.19E-04	1.15E-07	1.40E-05	2.48E-06	3.01E-04
Roads:	2.55E-07	4.32E-05	4.13E-08	6.99E-06	2.55E-07	4.32E-05	9.43E-07	1.60E-04	4.13E-08	6.99E-06	8.89E-07	1.51E-04
Stockpiles:	6.80E-08	1.14E-05	2.55E-07	4.28E-05	6.80E-08	1.14E-05	2.66E-07	4.46E-05	1.16E-08	1.95E-06	2.51E-07	4.20E-05
Total Plant:	1.01E-06	1.36E-04	2.88E-06	3.53E-04	1.01E-06	1.36E-04	3.85E-06	5.24E-04	1.68E-07	2.29E-05	3.63E-06	4.94E-04

ND = No data available

Air Modeling Report
Figures for Section 3.3

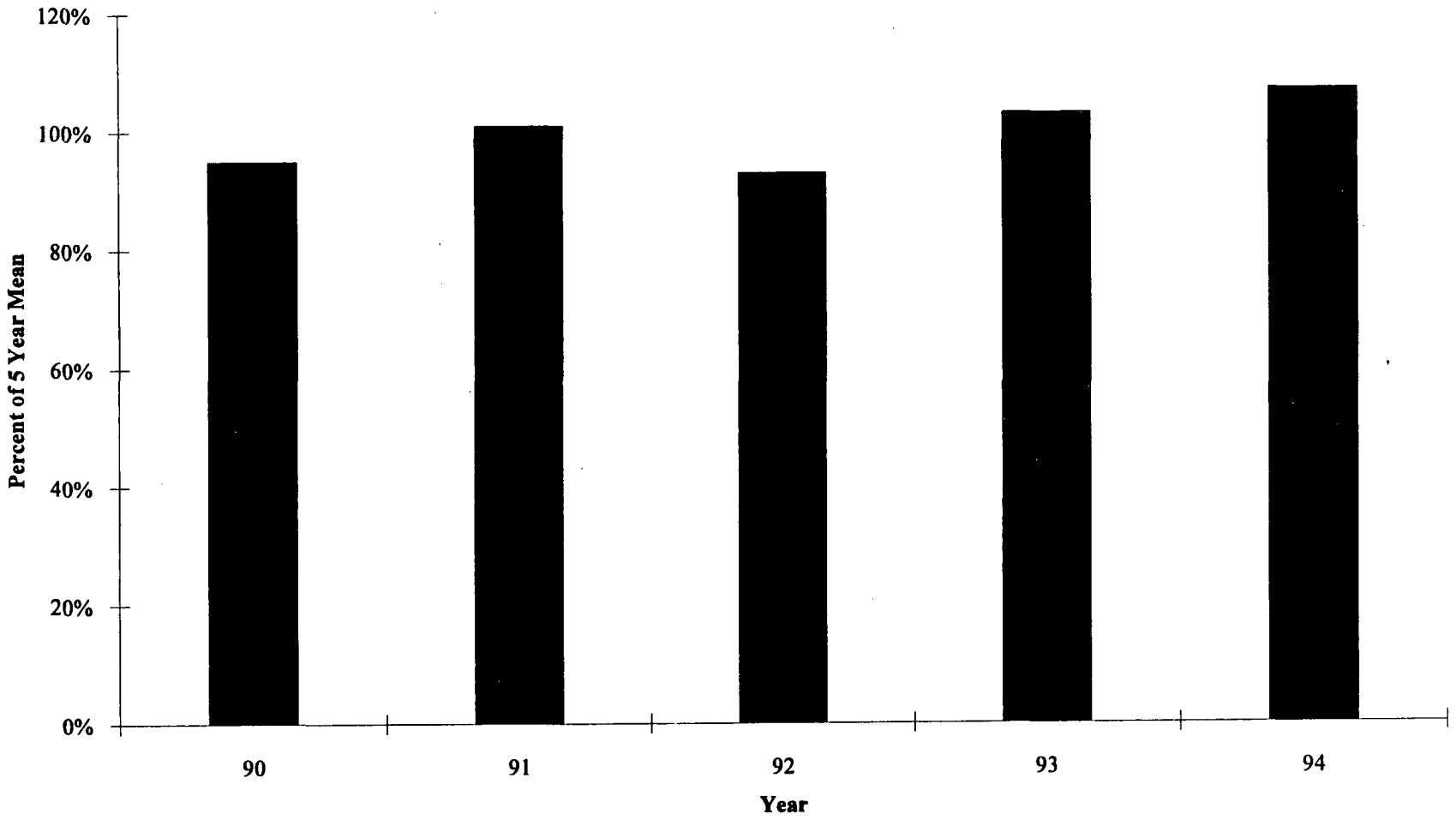
Figure 3.1.2-1: FMC Production Rates Compared to 5 Year Mean



FMCMEAN.XLS Chart 1

5/11/95

Figure 3.1.2-2: J.R. Simplot Co. Don Plant Equivalent Phosphoric Acid Production Compared to 5 Year Mean



FMCMEAN.XLS Chart 4

5/11/95

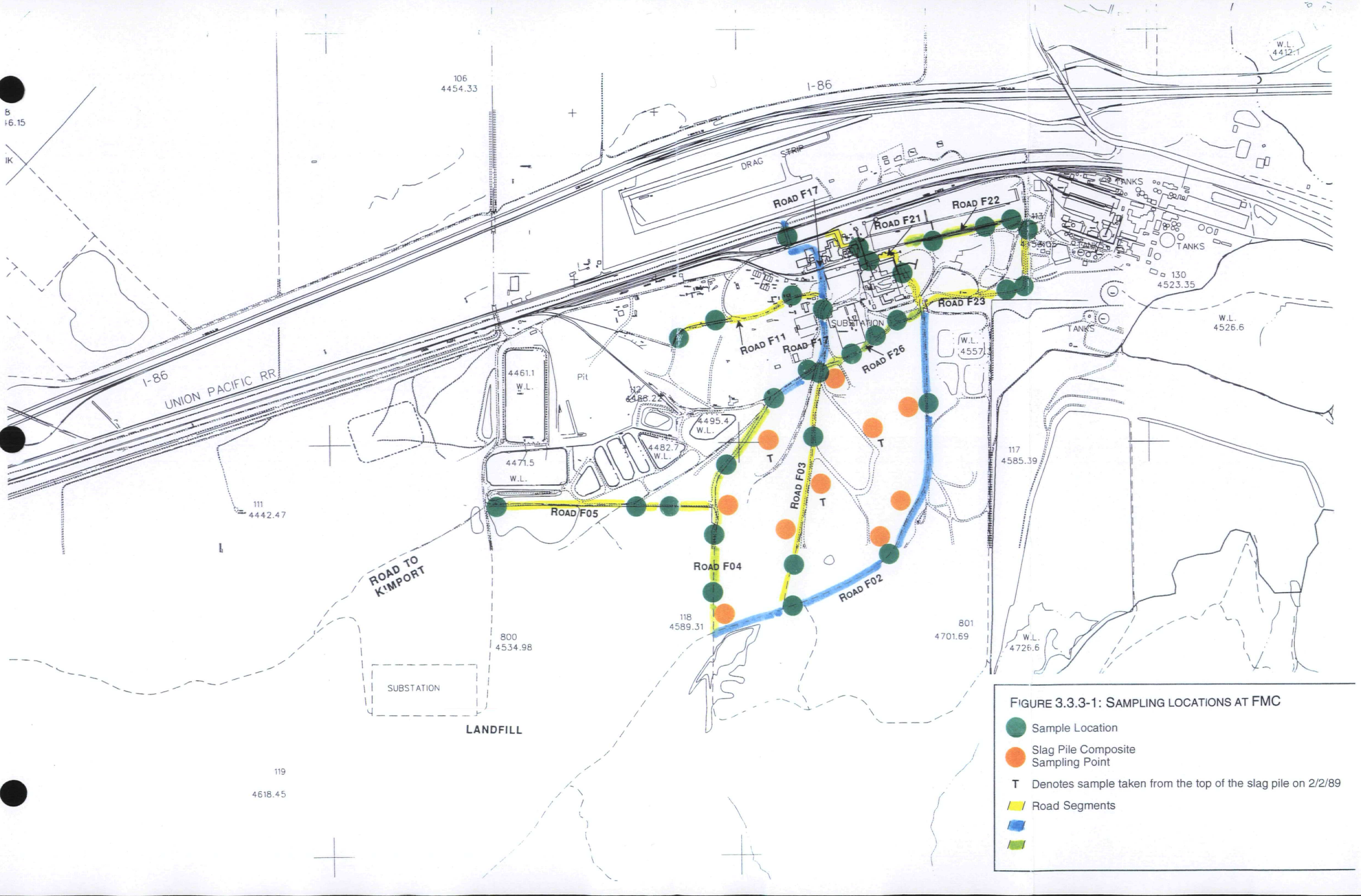


FIGURE 3.3.3-1: SAMPLING LOCATIONS AT FMC

- Sample Location
- Slag Pile Composite Sampling Point
- T Denotes sample taken from the top of the slag pile on 2/2/89
- Road Segments

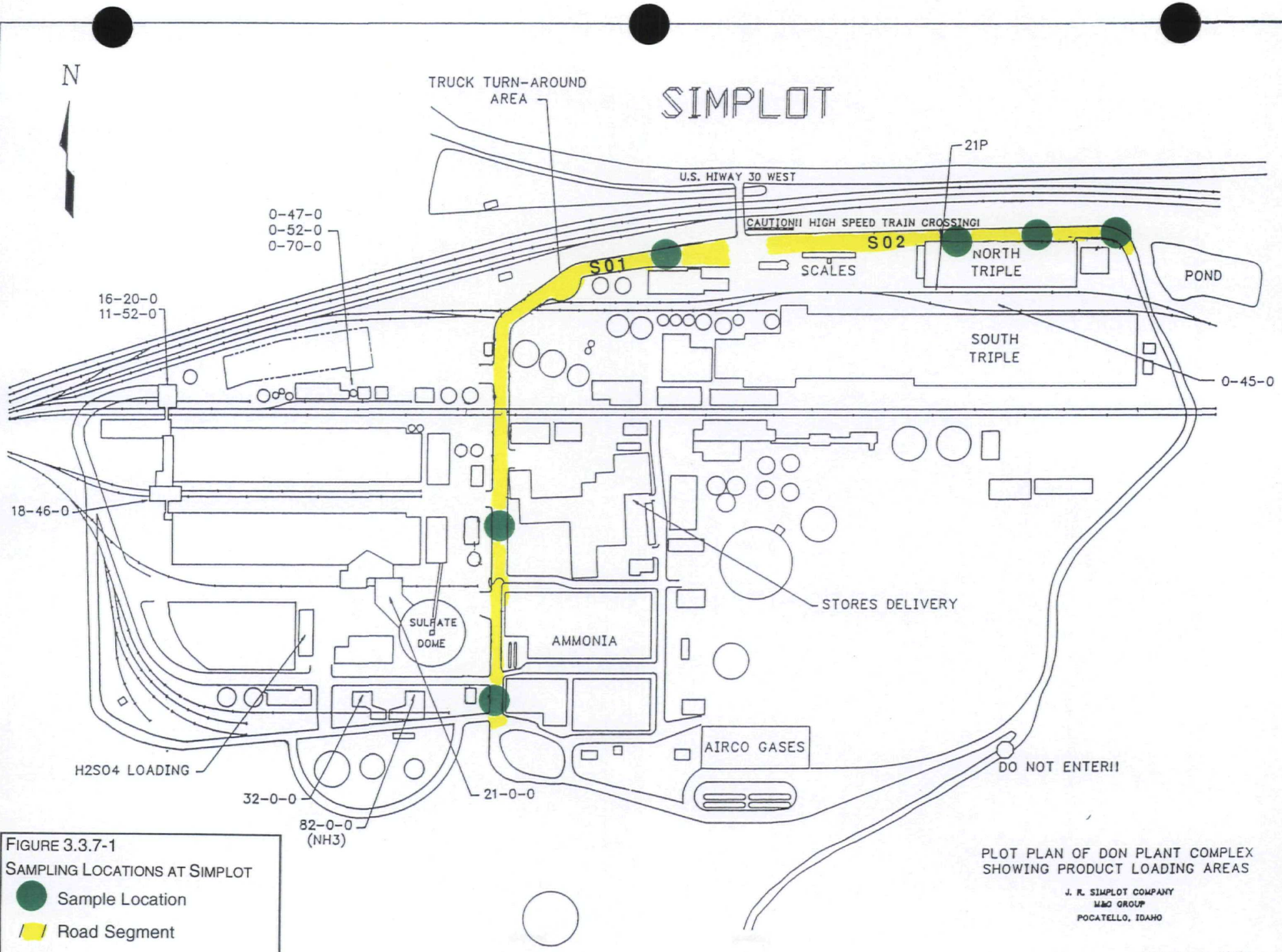


FIGURE 3.3.7-1
SAMPLING LOCATIONS AT SIMPLOT

Sample Location

Road Segment

3.4 PLANT PARAMETERS

Characteristics of individual sources (source parameters) provide necessary input for the atmospheric dispersion models. The atmospheric dispersion models (Section 4.1 describes the overall modeling approach) allow for three categories of sources: point, area, and line sources. Point sources are processes vented from a stack or control device. Area sources are process fugitives not vented through a stack or control device, but include low-level emissions, such as windblown fugitive dust. Line sources typically are used to represent sources such as roads and the gypsum stack dike. Point, area, and line sources were separated into different worksheet areas in the emissions inventories because they are modeled using two separate programs selected for their ability to model each source type.

Other characteristics for each type of source used in the modeling study were:

- Stack operating conditions (i.e., location, height, diameter, temperature, velocity);
- Area operating size and location, emission height above ground, and particle size fractions;
- Line location, length, and width, emission height above ground, and particle size fraction.

3.4.1 MODEL INPUTS

Each of the models used requires different types of information. The point sources were modeled in InterISC2. The area and line sources were modeled in FDM.

InterISC2. The InterISC2 model (Section 4.4) calculates the atmospheric dispersion of emissions from stack (point) sources only. The model requirements for the point sources are presented in Tables 3.4.1-1 through 3.4.1-3 which list stack data for FMC, Simplot, and BAPCO, respectively. The stack information required for model inputs were stack name and number, location in UTM coordinates, height above ground, exhaust flow or velocity of exiting gas, inside diameter measurement, and gas exit temperature.

Additional information was required for a few point sources. FMC's pressure relief vents (PRV), secondary condenser flare, and CO flare pit required calculations of both daily and average annual parameters due to variable operating conditions.

Fugitive Dust Model. The Fugitive Dust Model (FDM) (Section 4.4) required information about fugitive source (area and line source) emission characteristics. Process fugitives and windblown fugitive dust sources are listed for each facility in Tables 3.4.1-4 through 3.4.1-6 for FMC, Simplot, and BAPCO, respectively. The tables list all of the sources that emit fugitive particulate matter (PM_{10}, TSP, particulate metals, radionuclides, and/or fluorides).

The FMC, Simplot, and BAPCO facilities contain numerous process fugitives from area and line sources. These combined area or line sources were located within a large general area for the sake of simplicity and computer model time limitations. The sources were combined with consideration to the type of material handled and the geographical location of the sources.

For clarity, Table 3.4.1-7 matches individual BAPCO emission inventory source names with the model source names found in Tables 3.4.1-3 and 3.4.1-6. The first column states the name used in the model source information tables. Each of these model sources contain one to several sources (as named in the emission inventories). The location of the emission inventory sources is designated as point fugitives, area fugitives, roads, or stockpiles. The point fugitives are listed with the point sources as fugitive emissions. The area sources, roads, and stockpiles are listed under their respective titles as controlled emissions.

For Simplot's unpaved road, the road was not combined with other roads but separated into several road sources. The road inventory lists the start to end point of each road segment. The road, which has many turns, was divided into straight line segments. The line segment end points were estimated from the facility maps.

FMC has twenty sources (Table 3.4.1-4) which were modeled as volume sources to simulate a release of emissions from several different height levels from each source. Volume sources are virtual area sources, according to the FDM user's guide (EPA, 1992d). In the user's guide, "The term *'volume sources'* is generally used to represent sources which have an initial vertical mixed extent" (EPA, 1992d). The initial vertical mixed extent is the initial height of the emissions over an area. An area source was defined and the emission rate for the source was proportioned to the number of vertical layers specified for the source.

It has been recognized that one source in particular, the FMC slag pit, presents difficulties for conventional model simulation techniques. Physically, the slag pit is located at or below grade level and is an indirect noncontinuous area-type source in nature. Emissions from this source vary from windblown dust, hot and cold slag material handling, and hot gas releases as the slag cools. The predominant emissions from the slag pit occur as a hot, buoyant plume. Traditional techniques used to model emissions from area sources were developed for a nonbuoyant, ground level release.

Additionally, the FMC furnace building (the largest single structure on the facility) adjoins the slag pit. The proximity of this building causes the slag pit plume to be emitted at different heights depending on the wind direction. For example, during the prevailing southwesterly wind flow, the slag pit plume would typically rise up the side of the furnace building and disperse above the building height (at a minimum). Winds from the northeast would cause the slag pit plume to become trapped in the building wake cavity southwest of the furnace building, behaving as if the plume were emitted at ground level.

While these examples are simplifications, it is important to note that none of the EPA models used in this study (ISC2, Complex-I, nor FDM) have the ability to correctly simulate this source plume behavior. The current simulation for the slag pit assumes that it is a FDM volume source, equal to the height of the furnace building with no thermal plume rise. This is a conservative simulation. It is likely, however, that due to thermal effects, the slag pit plume will rise and

correspondingly become more diffuse, due to the presence of the building's wake, resulting in lower offsite concentrations. Further study and analysis of this source may be conducted in the future.

Information required for FDM inputs for area or volume sources were:

- Area or volume source name and source number
- Center of area or volume location in UTM coordinates
- Area or volume side length and width
- Emission release height
- Area or volume source rotation from UTM north

Information required for FDM inputs for line sources were:

- Road segment name and source number
- Two road segment end points in UTM coordinates
- Road height
- Road width

3.4.2 DATA LIMITATIONS

Plant parameter data presented in this analysis are based on stack testing results and engineering judgment. Older stack test data may not be applicable due to process changes that have occurred over the years. For those stacks without test information, vendor information and/or engineering calculations were used to estimate these stack parameters.

Area or line sources were located over the approximate operational area or building from which the emissions originated. Buildings generally release fugitive emissions through vents or other openings in the building. Fugitive emissions from buildings were generally assumed to be emitted at half the building height. The combined area sources represent a low-level release.

Because the emissions are fairly uniform over the general area, area source modeling best represents their net impact. Twenty FMC sources were modeled as volume sources to simulate a release of emissions from several different height levels from the sources. As discussed in Section 3.4.1, simulation of the FMC slag pit is viewed as a conservative approximation that may overstate source impact.

For FMC, roads in the vicinity of the slag pit were combined and modeled as an area source. The area source size was calculated based on the actual summation of the square area of the roads and of the road emission rates for the area source. These combined area sources were sufficient to simulate the effects of the roads. For Simplot, the paved roads were combined into five line sources.

Source parameter information was available for BAPCO through the Power-Bannock Counties Particulate Matter (PM_{10}) Air Quality Improvement Plan as part of the SIP. The BAPCO source parameters are listed in Appendix C of the Pocatello PM_{10} SIP Dispersion Modeling Study (TRC, 1993). BAPCO's stockpiles and process fugitives were simulated in several area sources located in the vicinity of the actual process and/or storage areas. The road's emissions were summed together and spread appropriately among the area sources.

Capture and Control Efficiency

One area of data limitation is the assignment of a capture efficiency (CAP) and control efficiency (CE) for a point source. The CAP and CE values assigned to sources by the EPA or IDEQ in the 1992 SIP inventory, or assigned by IDEQ representatives in recent SIP inventory revisions, were used in the CERCLA inventory, unless better CAP/CE information was available.

The CAP and CE values assigned to a source are used to estimate the fugitive emissions from the source by back-calculation. For point sources that have been characterized using stack tests, the fugitive emission rate is directly proportional to the CAP and CE; the more efficient the point source emission control, the greater the potential fugitive emission. For this reason, assignment

of the CAP or CE has a significant effect on the calculated fugitive emission. Since it was not possible to confirm these calculated fugitive emissions using field sampling methods, it is possible that these emissions are overestimated.

One case in point: Fugitive emissions of TSP from the FMC dust silo baghouse (source number 17) were estimated at 156.4 tons/yr, assuming a CE of 99.8 % and CAP of 97.5%. However, if a CAP of 97.5% and a CE of 99.0% were used, these emissions would be reduced to 31.3 tons/yr. Given the physical characteristics of these sources, it would not be practical to resolve the CAP and CE beyond the assumptions used.

Control efficiencies for a point source are usually supplied by the vendor of the control device or derived from inlet/outlet source tests on the point source. Capture efficiencies are somewhat less definable, and are subject to variation depending on the nature of the point source. For this reason CAPS and CEs used in the CERCLA inventory were revised for consistency with the 1992 SIP inventory, unless better CAP/CE information was available.

Air Modeling Report
Tables for Section 3.4

Table 3.4.1-1
FMC Corporation Summary of Point Sources

Source	Stack Name	Foot-notes	Location UTM Coord. East	North	Height (m)	Airflow (ACFM)	Velocity (m/sec)	Diameter (m)	Temp. (K)	Height (ft)	Diameter (in.)	Temp. (f)
1	East Shale Baghouse	1	374603.1	4751600.0	4.0	2400	8.73	0.41	294.3	13.00	16.00	70
2	Middle Shale Baghouse	1	374525.8	4751573.7	5.5	10000	10.35	0.76	294.3	18.00	30.00	70
3	West Shale Baghouse	1	374479.0	4751560.9	11.3	17000	18.50	0.74	294.3	37.00	29.25	70
4	#1 Cal. East Scrubber	1	374576.7	4751344.3	27.4	94900	5.71	3.16	327.6	90.00	124.45	130
5	#1 Cal. West Scrubber	1	374569.3	4751334.9	27.4	94900	5.71	3.16	327.6	90.00	124.45	130
6	#2 Cal. East Scrubber	1	374579.9	4751284.3	27.4	103719	6.24	3.16	327.6	90.00	124.45	130
7	#2 Cal. West Scrubber	1	374573.8	4751275.6	27.4	103719	6.24	3.16	327.6	90.00	124.45	130
8	#1 Cooler East Vent	1	374561.4	4751353.7	12.8	36000	7.28	1.72	588.7	42.00	NA	600
9	#1 Cooler West Vent	1	374560.0	4751353.3	12.8	36000	7.28	1.72	477.6	42.00	NA	400
10	#2 Cooler East Vent	1	374581.8	4751302.4	12.5	50000	8.98	1.83	588.7	41.00	72.00	600
11	#2 Cooler West Vent	1	374572.5	4751299.6	12.5	45000	8.08	1.83	477.6	41.00	72.00	400
12	Discharge South Baghouse	1	374625.7	4751366.8	6.4	15000	24.25	0.61	305.4	21.00	24.00	90
13	Discharge North Baghouse	1	374623.4	4751374.3	6.4	15000	24.25	0.61	305.4	21.00	24.00	90
14	East Nodule Baghouse	1	374558.4	4751452.5	12.8	21000	15.09	0.91	294.3	42.00	36.00	70
15	West Nodule Baghouse	1	374535.8	4751448.2	12.8	21000	15.09	0.91	294.3	42.00	36.00	70
16	Stockpile Baghouse	1	374610.9	4751430.1	3.5	20000	15.65	0.88	294.3	11.50	34.50	70
17	Dust Silo Baghouse	1	374488.4	4751425.3	20.9	22000	15.81	0.91	294.3	68.50	36.00	70
18	East Burden Baghouse	1	374397.0	4751385.7	34.1	80000	20.69	1.52	294.3	112.01	60.00	70
19	West Burden Baghouse	1	374380.7	4751380.6	34.1	80000	20.69	1.52	294.3	112.01	60.00	70
20	Coke Baghouse	1	374545.0	4751454.8	12.8	21000	15.09	0.91	294.3	42.00	36.00	70
21	Phos Dock Scrubber	1	374400.2	4751467.6	15.2	25000	11.00	1.17	305.4	50.00	46.00	90
22	Boiler #3	1	374443.0	4751473.5	9.8	4500	2.67	1.01	422.0	32.00	39.60	300
23	Boiler #4	1	374439.7	4751484.3	9.8	4500	2.67	1.01	422.0	32.00	39.60	300
24	#1 Fur. Tap Hood Vent	1	374419.9	4751410.9	34.0	40000	16.17	1.22	294.3	111.50	48.00	70
25	#2 Fur. Tap Hood Vent	1	374420.9	4751409.6	34.0	40000	16.17	1.22	294.3	111.50	48.00	70
26	#3 Fur. Tap Hood Vent	1	374355.1	4751390.9	34.0	40000	16.17	1.22	294.3	111.50	48.00	70
27	#4 Fur. Tap Hood Vent	1	374356.8	4751389.4	34.0	40000	16.17	1.22	294.3	111.50	48.00	70
28	#1 Fur. PRV Stack	1	374424.3	4751408.7	41.0	5500	5.69	0.76	773.2	134.50	30.00	932
29	#2 Fur. PRV Stack	1	374421.6	4751407.9	41.0	5500	5.69	0.76	773.2	134.50	30.00	932
30	#3 Fur. PRV Stack	1	374360.3	4751388.9	41.0	5500	5.69	0.76	773.2	134.50	30.00	932
31	#4 Fur. PRV Stack	1	374357.7	4751387.9	41.0	5500	5.69	0.76	773.2	134.50	30.00	932
32	#1 Fur. CO Flare	2	374444.8	4751416.2	38.7	5500	20.00	1.43	1273.2	127.01	56.19	1832
33	#2 Fur. CO Flare	2	374391.3	4751398.1	38.7	5500	20.00	1.43	1273.2	127.01	56.19	1832
34	#3 Fur. CO Flare	2	374390.9	4751397.9	38.7	5500	20.00	1.43	1273.2	127.01	56.19	1832
35	#4 Fur. CO Flare	2	374336.9	4751382.2	38.7	5500	20.00	1.43	1273.2	127.01	56.19	1832
36	Sec. Cond. Flare	2,3	374498.7	4751401.8	43.5	9666.67	20.00	2.85	1273.2	142.61	112.38	1832
36	Sec. Cond. Flare	2,4	374498.7	4751401.8	36.7	1121.25	20.00	0.97	1273.2	120.41	38.27	1832
37	CO Flare Pit	2,3	374639.6	4751323.6	7.8	2416.67	20.00	1.43	1273.2	25.50	56.19	1832
37	CO Flare Pit	2,4	374639.6	4751323.6	4.0	608.47	20.00	0.72	1273.2	13.20	28.20	1832

Footnotes:

1. Velocity was calculated using the following formula:
   velocity (m/s) = [airflow (ACFM)] / [(Diameter (m)/2)^2 * PI * 35.31998 (ft3/m3) * 60 (sec/min)]
2. Texas Air Control Board - Modeling Guidelines - Oct. 1988 - Page 23.
   Effective flare diameter calculated using Texas Air Control Board Guidelines as follows:
   D = sqrt (10E-6 * qn) where: qn = q(1-0.048 * sqrt(MW))
   q = gross heat release in cal/sec
   MW = weighted (by volume) average molecular weight of the mixture being burned.
   Flare heights = the vertical flare height (calculated) + the true stack height (given).
3. Daily parameters.
4. Average annual parameters.

Table 3.4.1-2 J.R. Simplot Summary of Point Sources

Source Number	Stack Name	Foot-notes	Location UTM Coord. East	Location UTM Coord. North	Height (m)	Airflow (ACFM)	Diameter (m)	Temp. (K)	Velocity (m/sec)	Height (ft)	Diameter (ft)	Temp. (°F)	Comments
38	Phos Acid	1	375616.5	4751615.0	54.56	85,000	1.83	311	15.27	179.01	6.00	100	
39	Granulation #1 Rec/Gran	1	375412.8	4751633.0	29.90	22,400	0.89	350	17.03	98.10	2.92	171	
40	Granulation #1 Baghouse	1	375416.3	4751638.0	29.90	15,000	0.76	341	15.52	98.10	2.50	155	
41	Granulation #1 Dryer	1	375413.2	4751639.0	29.90	40,300	1.19	332	16.99	98.10	3.92	138	
42	Granulation #2 TGS	1	375401.1	4751567.0	45.70	70,900	1.83	311	12.74	149.94	6.00	100	
43	Granulation #2 Cooler	1	375395.9	4751603.0	18.29	25,960	0.91	331	18.65	60.00	3.00	136	Moved July 91
44	Granulation #3	1	375676.6	4751603.0	53.34	61,350	1.83	324	11.02	175.01	6.00	124	
45	Ammo-Sulfate Dryer	1	375421.8	4751575.0	23.20	6,400	0.51	311	14.90	76.12	1.67	100	
46	Ammo-Sulfate Cooler	1	375416.7	4751577.0	21.30	5,500	0.51	311	12.80	69.89	1.67	100	
47	C.E. Boiler	3	375552.6	4751640.0	13.72	18,689	0.88	505	14.50	45.00	2.89	449	
48	Foster-Wheeler Boiler	3	375546.2	4751643.0	10.67	37,407	1.22	505	15.10	35.00	4.00	449	
49	Keeler Boiler	3	375554.0	4751660.0	13.72	37,160	1.22	505	15.00	45.00	4.00	449	
50	H2O Reclaim North CT	2	375779.4	4751530.0	11.60	1,500,000	8.71	297	11.89	38.06	28.57	75	Two cells at 750,000 ACFM/cell
51	H2O Reclaim East CT	2	375816.8	4751488.0	10.70	2,250,000	10.66	297	11.89	35.11	34.99	75	Three cells at 750,000 ACFM/cell
52	H2O Reclaim West CT	2	375781.3	4751497.0	11.60	2,250,000	10.66	297	11.89	38.06	34.99	75	Three cells at 750,000 ACFM/cell
53	#1 Ammonia	3	375492.6	4751477.0	18.30	49,546	1.22	505	20.00	60.04	4.00	449	
54	#2 Ammonia	3	375477.3	4751430.0	18.30	49,546	1.22	505	20.00	60.04	4.00	449	
55	SPA Vent	1	375406.6	4751686.0	10.68	92	0.08	311	9.55	35.02	0.25	100	
56	Tank Farm Scrubber	1	375635.3	4751644.6	35.05	14,000	0.91	300	10.06	115.01	3.00	80	

Footnotes:

1. Velocity was calculated using the following formula:
   velocity (m/s) = airflow (ACFM) / (diameter [m]/2)^2 / pi / 35.31998 [ft3/m3] / 60 [sec/min]
2. Diameters were calculated using the following formula:
   diameter [m] = 2 * sqrt (airflow [ACFM] / 60 [sec/min] * 35.3417 [ft3/m3] / pi / velocity [m/s])
3. Airflows were calculated using the following formula:
   airflow [ACFM] = velocity [m/s] * pi * (diameter [m] / 2)^2 * 35.3198 [ft3/m3] * 60 [sec/min]

Table 3.4.1-3 Bannock Paving Company Summary of Point Sources

Source Number	Stack Name	Foot-notes	Location UTM Coord. East	Location UTM Coord. North	Height (m)	Airflow (ACFM)	Velocity (m/sec)	Diameter (m)	Temp. (K)	Comments
57	Coke Dryer Scrubber	1, 2	373613.5	4750914.0	12.8	60099.4	24.26	1.22	316.5	TRC Modeling Study
58	Coke Dryer Baghouse	1, 2	373613.5	4750914.0	7.6	29716.0	21.56	0.91	333.2	TRC Modeling Study
59	Drum Mixer Baghouse	1, 2	373839.9	4751273.0	10.7	57357.9	30.1	1.07	422	TRC Modeling Study

Footnotes:

1. Airflows were calculated using the following formula:
   airflow [ACFM] = velocity [m/s] * pi * (diameter [m] / 2)^2 * 35.3198 [ft3/m^3] * 60 [sec/min]
2. "Pocatello PM_{10} SIP Dispersion Modeling Study" Draft March 8, 1993 TRC Environmental Corporation

TABLE 3.4.1-4
FMC - Particle Size Distribution for PM_{10}

Area Sources			Center		Length		Height	Area Source	Particle Size Distribution			
Source	Source	Foot-	Location UTM Coord.		X	Y		Rotation	<2.5 μm	5 μm	10 μm	
#	Name	notes	East	North	(m)	(m)	(m)	(degrees)	(Normalized size fractions)			Reference / Comments
60	Slag Pile *	1, 7	374318.0	4750610.0	700.0	780.0	20.0	5	0.21	0.32	0.47	SET Chester Road Dust Analysis Slag Pile
61	Ferrophos Pile *	1	373810.0	4751010.0	80.0	40.0	0.0	150	0.36	0.28	0.36	AP-42 TB 11.2.3-2 (ver. 5/83) batch drop
62	Oversized Ore *	1	374850.0	4750700.0	200.0	160.0	20.0	0	0.27	0.32	0.41	SET Chester Analysis (average) of Baghouse Fines and Shale Ore
63	Calciner #1 *	3, 4, 6	374520.0	4751350.0	50.0	10.0	6.0	17.5	0.31	0.26	0.43	AP-42 Aggregate Handling TB 11.2.3-2
64	Calciner #2 *	3, 4, 6	374534.0	4751306.0	50.0	10.0	6.0	17.5	0.31	0.26	0.43	AP-42 Aggregate Handling TB 11.2.3-2
65	Cooler #1 *	2, 4, 6	374559.5	4751363.0	38.0	8.0	6.0	17.5	0.31	0.26	0.43	AP-42 Aggregate Handling TB 11.2.3-2
66	Cooler #2 *	2, 4, 6	374573.0	4751317.0	38.0	8.0	6.0	17.5	0.31	0.26	0.43	AP-42 Aggregate Handling TB 11.2.3-2
67	Discharge Baghouses *	2, 4, 6	374633.0	4751374.0	15.0	15.0	6.0	17.5	0.00	0.00	1.00	SET EPA Calculation
68	Dust Silo Baghouse *	2, 4	374485.0	4751425.5	10.0	8.0	10.0	17.5	0.00	0.00	1.00	SET for TSP
69	Phos Dock *	2, 4	374420.0	4751467.0	40.0	30.0	2.0	17.5	1.00	0.00	0.00	AP-42 Pg 5.11-3
70	Ore Receiving	1	374421.0	4751570.0	15.0	14.0	0.0	17.5	0.31	0.33	0.36	SET Chester Analysis of New Shale
71	Silica Handling *	1, 4	374611.0	4751461.0	8.0	4.0	5.5	17.5	0.31	0.26	0.43	AP-42 Aggregate Handling TB 11.2.3-2
72	Coke Handling *	3, 4	374549.0	4751460.2	5.0	4.0	0.0	17.5	0.39	0.23	0.39	AP-42 TB 7.2-2 Coke Pushing
73	Slag Pit *	1, 5	374400.0	4751330.0	110.0	67.0	0.0	17.5	0.00	0.00	1.00	SET Chester Slag Pit Study and Analysis
74	Proportioning Bldg. *	3, 6, 7	374557.0	4751440.8	38.1	14.6	20.0	17.5	0.00	0.00	1.00	SET for TSP
75	Furnace Bldg. *	2, 6, 7	374393.5	4751389.0	128.6	28.0	20.0	17.5	0.89	0.07	0.04	AP-42 Cat 8. Melting Pg. C.2-15
76	Briquetting Bldg. *	1, 7	374489.0	4751375.0	36.6	35.4	20.0	17.5	0.31	0.26	0.43	AP-42 Aggregate Handling TB 11.2.3-2
77	Roads centered on Slag Pit	6	374400.0	4751330.0	67.3	67.3	0.0	17.5	0.25	0.34	0.41	SET Chester Road Dust Analysis road 26
78	Roads centered on Slag Pile *	6	374318.0	4750610.0	74.6	74.6	20.0	0.0	0.27	0.36	0.36	SET Chester Road Dust Analysis road 3
79	Roads centered on Ore *	6	374769.0	4751598.0	49.0	49.0	0.0	14.0	0.22	0.34	0.44	SET Chester Road Dust Analysis road 22
80	Roads centered on Pond Area	6	373574.0	4750698.0	128.4	128.4	0.0	23.0	0.27	0.31	0.42	SET Chester Road Dust Analysis road 5
81	Ore Handling *	6	374769.0	4751598.0	550.0	155.0	8.0	14.0	0.29	0.33	0.37	SET Chester Analysis (avg.) of 3 shale types
82	Silica & Nodule Stockpiles *	6	374808.0	4751402.0	167.0	84.5	6.0	22.0	0.36	0.28	0.36	AP-42 TB 11.2.3-2 (ver. 5/83) batch drop
83	Pond 1C	2, 7	374866.0	4751111.0	95.0	95.0	20.0	0.0				
84	Pond 2C	2, 7	374770.0	4751120.0	61.0	105.0	20.0	0.0				
85	Pond 3C	2, 7	374770.0	4750989.0	84.0	132.0	20.0	0.0				
86	Pond 4C	2, 7	374877.0	4750996.0	75.0	111.0	20.0	0.0				
87	Solar Drying Pond	2	374831.3	4750850.0	182.9	121.9	20.0	0.0				

Footnotes:

* Modeled as volume sources.

1. Emission rate from materials handling.
2. Emission rate from fugitive emissions.
3. Emission rate includes materials handling and fugitive emissions.
4. Heights for materials handling and fugitive emissions are half the building height.
5. Height is half the furnace building height.
6. Sources with combined emissions.
7. Actual heights are greater than the model maximum height restriction of 20 meters.

TABLE 3.4.1-4 (continued)
FMC - Particle Size Distribution for TSP

Area Sources			Center		Length		Height	Area Source	Particle Size Distribution				
Source	Source	Foot-	Location UTM Coord.		X	Y		Rotation	<2.5 μm	5 μm	10 μm	30 μm	
#	Name	notes	East	North	(m)	(m)	(m)	(degrees)	(Normalized size fractions)				Reference / Comments
60	Slag Pile *	1, 7	374318.0	4750610.0	700.0	780.0	20.0	5.0	0.10	0.15	0.22	0.54	SET Chester Road Dust Analysis Slag Pile
61	Ferrophos Pile *	1	373810.0	4751010.0	80.0	40.0	0.0	150	0.18	0.14	0.18	0.51	AP-42 TB 11.2.3-2 (ver. 5/83) batch drop
62	Oversized Ore *	1	374850.0	4750700.0	200.0	160.0	20.0	0	0.15	0.18	0.23	0.44	SET Chester Analysis (average) of Baghouse Fines and Shale Ore
63	Calciner #1 *	3, 4, 6	374520.0	4751350.0	50.0	10.0	6.0	17.5	0.15	0.12	0.20	0.53	AP-42 Aggregate Handling TB 11.2.3-2
64	Calciner #2 *	3, 4, 6	374534.0	4751306.0	50.0	10.0	6.0	17.5	0.15	0.12	0.20	0.53	AP-42 Aggregate Handling TB 11.2.3-2
65	Cooler #1 *	2, 4, 6	374559.5	4751363.0	38.0	8.0	6.0	17.5	0.15	0.12	0.20	0.53	AP-42 Aggregate Handling TB 11.2.3-2
66	Cooler #2 *	2, 4, 6	374573.0	4751317.0	38.0	8.0	6.0	17.5	0.15	0.12	0.20	0.53	AP-42 Aggregate Handling TB 11.2.3-2
67	Discharge Baghouses *	2, 4, 6	374633.0	4751374.0	15.0	15.0	6.0	17.5	0.00	0.00	0.85	0.15	SET EPA Calculation
68	Dust Silo Baghouse *	2, 4	374485.0	4751425.5	10.0	8.0	10.0	17.5	0.00	0.00	0.85	0.15	SET for TSP
69	Phos Dock *	2, 4	374420.0	4751467.0	40.0	30.0	2.0	17.5	1.00	0.00	0.00	0.00	AP-42 Pg 5.11-3
70	Ore Receiving	1	374421.0	4751570.0	15.0	14.0	0.0	17.5	0.19	0.21	0.23	0.37	SET Chester Analysis of New Shale
71	Silica Handling *	1, 4	374611.0	4751461.0	8.0	4.0	5.5	17.5	0.15	0.12	0.20	0.53	AP-42 Aggregate Handling TB 11.2.3-2
72	Coke Handling *	3, 4	374549.0	4751460.2	5.0	4.0	0.0	17.5	0.33	0.20	0.33	0.13	AP-42 TB 7.2-2 Coke Pushing
73	Slag Pit *	1, 5	374400.0	4751330.0	110.0	67.0	0.0	17.5	0.00	0.00	0.45	0.55	SET Chester Slag Pit Study and Analysis
74	Proportioning Bldg. *	3, 6, 7	374557.0	4751440.8	38.1	14.6	20.0	17.5	0.00	0.00	0.85	0.15	SET for TSP
75	Furnace Bldg. *	2, 6, 7	374393.5	4751389.0	128.6	28.0	20.0	17.5	0.74	0.00	0.02	0.24	AP-42 TB 7.5-2 for Electric Arc Furnace
76	Briquetting Bldg. *	1, 7	374489.0	4751375.0	36.6	35.4	20.0	17.5	0.15	0.12	0.20	0.53	AP-42 Aggregate Handling TB 11.2.3-2
77	Roads centered on Slag Pit	6	374400.0	4751330.0	67.3	67.3	0.0	17.5	0.11	0.15	0.18	0.57	SET Chester Road Dust Analysis road 26
78	Roads centered on Slag Pile *	6	374318.0	4750610.0	74.6	74.6	20.0	0.0	0.12	0.16	0.16	0.56	SET Chester Road Dust Analysis road 3
79	Roads centered on Ore *	6	374769.0	4751598.0	49.0	49.0	0.0	14.0	0.12	0.18	0.23	0.48	SET Chester Road Dust Analysis road 22
80	Roads centered on Pond Area	6	373574.0	4750698.0	128.4	128.4	0.0	23.0	0.15	0.17	0.23	0.45	SET Chester Road Dust Analysis road 5
81	Ore Handling *	6	374769.0	4751598.0	550.0	155.0	8.0	14.0	0.18	0.21	0.23	0.38	SET Chester Analysis (avg.) of 3 shale types
82	Silica & Nodule Stockpiles *	6	374808.0	4751402.0	167.0	84.5	6.0	22.0	0.18	0.14	0.18	0.51	AP-42 TB 11.2.3-2 (ver. 5/83) batch drop
83	Pond 1C	2, 7	374866.0	4751111.0	95.0	95.0	20.0	0.0					
84	Pond 2C	2, 7	374770.0	4751120.0	61.0	105.0	20.0	0.0					
85	Pond 3C	2, 7	374770.0	4750989.0	84.0	132.0	20.0	0.0					
86	Pond 4C	2, 7	374877.0	4750996.0	75.0	111.0	20.0	0.0					
87	Solar Drying Pond	2	374831.3	4750850.0	182.9	121.9	20.0	0.0					

Footnotes:

* Modeled as volume sources.

1. Emission rate from materials handling.
2. Emission rate from fugitive emissions.
3. Emission rate includes materials handling and fugitive emissions.
4. Heights for materials handling and fugitive emissions are half the building height.
5. Height is half the furnace building height.
6. Sources with combined emissions.
7. Actual heights are greater than the model maximum height restriction of 20 meters.

Table 3.4.1-5
J. R. Simplot - Particle Size Distribution for PM10

Area Sources			Center		Length		Height	Area Source	Particle Size Distribution			
Source		Foot-	Location UTM Coord.		X	Y		Rotation	<2.5 μm	5 μm	10 μm	
Number	Name	notes	East	North	(m)	(m)	(m)	(degrees)	(Normalized size fractions)			Reference
88	#400 Phos Acid Plant	3, 4	375585.1	4751627.0	30.2	12.0	13	-17.1	0.00	0.00	1.00	SET
89	Granulation #1 Loading	1, 4	375258.4	4751741.0	15.2	12.6	2	-17.1	0.07	0.27	0.67	AP-42 App. C.2 Cat. 6 Grain Handling
90	Granulation #1	2, 4	375413.9	4751637.0	34.6	15.6	11.8	-17.1	0.00	0.00	1.00	SET
91	Granulation #2 Loading	1, 4	375226.8	4751671.0	25.8	9.0	2	-17.1	0.07	0.27	0.67	AP-42 App. C.2 Cat. 6 Grain Handling
92	Granulation #2	2	375393.6	4751584.0	32.7	15.2	15	-17.1	0.00	0.00	1.00	SET
93	Ammo-Sulfate Loading	1, 4	375353.6	4751556.0	27.3	19.2	2	-17.1	0.07	0.27	0.67	AP-42 App. C.2 Cat. 6 Grain Handling
94	Ammo-Sulfate	2, 4	375422.0	4751583.0	19.5	10.1	10.7	-17.1	0.00	0.00	1.00	SET
95	Granulation #3 Loading	1, 4	375825.1	4751618.0	14.3	8.7	2	-17.1	0.07	0.27	0.67	AP-42 App. C.2 Cat. 6 Grain Handling
96	Granulation #3	2, 4	375715.4	4751622.0	67.4	45.0	8.4	-17.1	0.00	0.00	1.00	SET
97	N Gypsum Pond	2	376083.7	4751060.6	244.8	244.8	12	0.0				
98	M Gypsum Pond	2	376022.8	4750298.4	173.1	173.1	20	0.0				
99	S Gypsum Pond	2	375078.1	4750025.3	244.76	244.76	20	0.0				
Line Sources			1st set		2nd set		Height	Source	Particle Size Distribution			
Source		Foot-	X	Y	X	Y		Width	<2.5 μm	5 μm	10 μm	
Number	Name	notes	(UTM)	(UTM)	(UTM)	(UTM)	(m)	(m)	(Normalized size fractions)			Reference / Comments
100	South Gyp Stack - 1	3, 6	374955.7	4750153.4	375310.4	4750800.5	20	4.57	0.00	0.00	1.00	AP-42 TB 8.19.1-1
101	South Gyp Stack - 2	3, 6	375310.4	4750800.5	376240.9	4750595.9	20	4.57	0.00	0.00	1.00	AP-42 TB 8.19.1-1
102	North Gyp Stack	3, 6	375452.2	4751117.7	376332.7	4751268.0	12	4.57	0.00	0.00	1.00	AP-42 TB 8.19.1-1
103	TSP Road	5	375899.1	4751641.0	375657.5	4751719.0	0	5.79	0.28	0.33	0.39	SET Chester Road Dust Analysis road 2
104	Cooling Tower Road	5	375899.1	4751641.0	375745.8	4751342.0	0	5.79	0.28	0.33	0.39	SET Chester Road Dust Analysis road 2
105	Airco Road	5	375745.8	4751342.0	375405.8	4751415.0	0	5.79	0.28	0.33	0.39	SET Chester Road Dust Analysis road 2
106	Sulfuric Road	5	375407.5	4751480.0	375187.5	4751554.0	0	5.79	0.30	0.33	0.36	SET Chester Road Dust Analysis road 1
107	Granulation Road	5	375185.8	4751737.0	375187.5	4751554.0	0	5.79	0.30	0.33	0.36	SET Chester Road Dust Analysis road 1
108	EWI => Gyp Stack	8	375781.7	4751382.2	375429.1	4751116.9	0	5.79	0.25	0.31	0.44	AP-42 11.2.1-3
109	Gyp Stack => 1		375429.1	4751116.9	376200.5	4750862.9	5	5.79	0.25	0.31	0.44	AP-42 11.2.1-3
110	1 => 2		376200.5	4750862.9	376240.9	4751011.8	10	5.79	0.25	0.31	0.44	AP-42 11.2.1-3
111	2 => 3		376240.9	4751011.8	376582.1	4751011.8	15	5.79	0.25	0.31	0.44	AP-42 11.2.1-3
112	3 => Met Tower	7	376582.1	4751011.8	376519.1	4750605.7	20	5.79	0.25	0.31	0.44	AP-42 11.2.1-3

Footnotes:

* Modeled as volume sources.

1. Emission rate from materials handling.
2. Emission rate from fugitive emissions.
3. Emission rate includes materials handling and fugitive emissions.
4. Heights for materials handling and fugitive emissions are half the building height.
5. Sources with combined emissions.
6. Actual heights are greater than the model maximum height restriction of 20 meters.
7. Met Tower = J.R. Simplot Meteorological Tower (Site 7)
8. EWI = East West Intersection on the gypsum stack going to the Meteorological Tower.

Table 3.4.1-5 (continued) J. R. Simplot - Particle Size Distribution for TSP

Area Sources			Center		Length		Height	Area Source	Particle Size Distribution				
Source Number	Name	Foot-notes	Location UTM Coord. East	North	X (m)	Y (m)	(m)	Rotation (degrees)	<2.5 µm	5 µm	10 µm	30 µm	Reference
									(Normalized size fractions)				
88	#400 Phos Acid Plant	3, 4	375585.1	4751627.0	30.2	12.0	13	-17.1	0.00	0.00	0.00	1.00	SET
89	Granulation #1 Loading	1, 4	375258.4	4751741.0	15.2	12.6	2	-17.1	0.00	0.00	0.00	1.00	AP-42 No particle sizing greater than 10 µm
90	Granulation #1	2, 4	375413.9	4751637.0	34.6	15.6	11.8	-17.1	0.00	0.00	0.00	1.00	SET
91	Granulation #2 Loading	1, 4	375226.8	4751671.0	25.8	9.0	2	-17.1	0.00	0.00	0.00	1.00	AP-42 No particle sizing greater than 10 µm
92	Granulation #2	2	375393.6	4751584.0	32.7	15.2	15	-17.1	0.00	0.00	0.00	1.00	SET
93	Ammo-Sulfate Loading	1, 4	375353.6	4751556.0	27.3	19.2	2	-17.1	0.00	0.00	0.00	1.00	AP-42 No particle sizing greater than 10 µm
94	Ammo-Sulfate	2, 4	375422.0	4751583.0	19.5	10.1	10.7	-17.1	0.00	0.00	0.00	1.00	SET
95	Granulation #3 Loading	1, 4	375825.1	4751618.0	14.3	8.7	2	-17.1	0.00	0.00	0.00	1.00	AP-42 No particle sizing greater than 10 µm
96	Granulation #3	2, 4	375715.4	4751622.0	67.4	45.0	8.4	-17.1	0.00	0.00	0.00	1.00	SET
97	N Gypsum Pond	2	376083.7	4751060.6	244.8	244.8	12	0.0					
98	M Gypsum Pond	2	376022.8	4750298.4	173.1	173.1	20	0.0					
99	S Gypsum Pond	2	375078.1	4750025.3	244.76	244.76	20	0.0					

Line Sources			1st set		2nd set		Height	Source	Particle Size Distribution				
Source Number	Name	Foot-notes	X (UTM)	Y (UTM)	X (UTM)	Y (UTM)	(m)	Width (m)	<2.5 µm	5 µm	10 µm	30 µm	Reference / Comments
									(Normalized size fractions)				
100	South Gyp Stack - 1	3, 6	374955.7	4750153.4	375310.4	4750800.5	20	4.57	0.00	0.00	0.00	1.00	AP-42 TB 8.19.1-1
101	South Gyp Stack - 2	3, 6	375310.4	4750800.5	376240.9	4750595.9	20	4.57	0.00	0.00	0.00	1.00	AP-42 TB 8.19.1-1
102	North Gyp Stack	3, 6	375452.2	4751117.7	376332.7	4751268.0	12	4.57	0.00	0.00	0.00	1.00	AP-42 TB 8.19.1-1
103	TSP Road	5	375899.1	4751641.0	375657.5	4751719.0	0	5.79	0.17	0.20	0.23	0.40	SET Chester Road Dust Analysis road 2
104	Cooling Tower Road	5	375899.1	4751641.0	375745.8	4751342.0	0	5.79	0.17	0.20	0.23	0.40	SET Chester Road Dust Analysis road 2
105	Airco Road	5	375745.8	4751342.0	375405.8	4751415.0	0	5.79	0.17	0.20	0.23	0.40	SET Chester Road Dust Analysis road 2
106	Sulfuric Road	5	375407.5	4751480.0	375187.5	4751554.0	0	5.79	0.20	0.22	0.24	0.34	SET Chester Road Dust Analysis road 1
107	Granulation Road	5	375185.8	4751737.0	375187.5	4751554.0	0	5.79	0.20	0.22	0.24	0.34	SET Chester Road Dust Analysis road 1
108	EWI => Gyp Stack	8	375781.7	4751382.2	375429.1	4751116.9	0	5.79	0.12	0.13	0.20	0.55	AP-42 11.2.1-3
109	Gyp Stack => 1		375429.1	4751116.9	376200.5	4750862.9	5	5.79	0.12	0.13	0.20	0.55	AP-42 11.2.1-3
110	1 => 2		376200.5	4750862.9	376240.9	4751011.8	10	5.79	0.12	0.13	0.20	0.55	AP-42 11.2.1-3
111	2 => 3		376240.9	4751011.8	376582.1	4751011.8	15	5.79	0.12	0.13	0.20	0.55	AP-42 11.2.1-3
112	3 => Met Tower	7	376582.1	4751011.8	376519.1	4750605.7	20	5.79	0.12	0.13	0.20	0.55	AP-42 11.2.1-3

Footnotes:

* Modeled as volume sources.

1. Emission rate from materials handling.
2. Emission rate from fugitive emissions.
3. Emission rate includes materials handling and fugitive emissions.
4. Heights for materials handling and fugitive emissions are half the building height.
5. Sources with combined emissions.
6. Actual heights are greater than the model maximum height restriction of 20 meters.
7. Met Tower = J.R. Simplot Meteorological Tower (Site 7)
8. EWI = East West Intersection on the gypsum stack going to the Meteorological Tower.

Table 3.4.1-6 Bannock Paving Company Summary of Area Sources

PM_{10} Area Sources		Center		Length		Height	Area Source	Particle Size Distribution			
Source		Location UTM Coord.		X	Y	(1,2)	Rotation	<2.5 μm	5 μm	10 μm	
Number	Name	East	North	(m)	(m)	(m)	(degrees)	(normalized size fractions)			Reference / Comments
113	Slag 1	373420.5	4751054.0	175.2	115.4	5.00	90.00	0.21	0.32	0.47	SET Chester Road Dust Analysis Slag Pile
114	Slag 2	373681.6	4751123.0	125.0	78.4	5.00	74.97	0.21	0.32	0.47	SET Chester Road Dust Analysis Slag Pile
	Slag 3	373636.6	4751101.0	72.7	33.5	0.00	146.20	0.21	0.32	0.47	SET Chester Road Dust Analysis Slag Pile
1	Coke 1	373582.4	4750886.0	231.1	116.3	5.00	44.44	0.39	0.23	0.39	AP-42 TB 7.2-2 Coke Pushing
2	Coke 2	373624.9	4750930.0	100.1	31.1	0.00	49.21	0.39	0.23	0.39	AP-42 TB 7.2-2 Coke Pushing
3	Asphalt 1	373868.3	4751249.0	165.4	154.9	5.00	9.34	0.06	0.19	0.75	AP-42 P 8.1-9 TB 8.1-2 Uncontrolled
4	Asphalt 2	373844.9	4751275.0	53.7	39.9	0.00	11.22	0.06	0.19	0.75	AP-42 P 8.1-9 TB 8.1-2 Uncontrolled

TSP Area Sources		Center		Length		Height	Area Source	Particle Size Distribution				
Source		Location UTM Coord.		X	Y	(1,2)	Rotation	<2.5 μm	5 μm	10 μm	30 μm	
Number	Name	East	North	(m)	(m)	(m)	(degrees)	(normalized size fractions)				Reference / Comments
113	Slag 1	373420.5	4751054.0	175.2	115.4	5.00	90.00	0.10	0.15	0.22	0.54	SET Chester Road Dust Analysis Slag Pile
114	Slag 2	373681.6	4751123.0	125.0	78.4	5.00	74.97	0.10	0.15	0.22	0.54	SET Chester Road Dust Analysis Slag Pile
115	Slag 3	373636.6	4751101.0	72.7	33.5	0.00	146.20	0.10	0.15	0.22	0.54	SET Chester Road Dust Analysis Slag Pile
116	Coke 1	373582.4	4750886.0	231.1	116.3	5.00	44.44	0.33	0.20	0.33	0.13	AP-42 TB 7.2-2 Coke Pushing
117	Coke 2	373624.9	4750930.0	100.1	31.1	0.00	49.21	0.33	0.20	0.33	0.13	AP-42 TB 7.2-2 Coke Pushing
118	Asphalt 1	373868.3	4751249.0	165.4	154.9	5.00	9.34	0.03	0.09	0.35	0.53	AP-42 P 8.1-9 TB 8.1-2 Uncontrolled
119	Asphalt 2	373844.9	4751275.0	53.7	39.9	0.00	11.22	0.03	0.09	0.35	0.53	AP-42 P 8.1-9 TB 8.1-2 Uncontrolled

TABLE 3.4.1-7
BAPCO NOMENCLATURE

Slag 1, 2, 3 (emissions based on area source size for each and activities within each area)	Area Fugitives – Slag Crushing Roads – Unpaved Roads (1/7 emissions); Paved Roads (1/7 emissions) Storage Piles – Slag Crusher
Coke 1, 2 (emissions based on area source size for each and activities within each area)	Point Fugitives – Coke Dryer Scrubber, Coke Dryer Baghouse Area Fugitives – Coke Plant Roads – Unpaved Roads (1/7 emissions), Paved Roads (1/7 emissions) Storage Piles – Coke Plant
Asphalt 1, 2 (emissions based on area source size for each and activities within each area)	Point Fugitives – Drum Mixer Baghouse Area Fugitives – Asphalt Plant Roads – Unpaved Roads (1/7 emissions), Paved Roads (1/7 emission) Storage Piles – Asphalt Hot Plant

3.5 PM_{10}, TSP, AND FLUORIDES

The inventories for PM_{10}, TSP, and fluorides were prepared using the same general source information. The equations used in the inventories are explained in detail in Appendix AF.

Fluoride emissions were estimated from the TSP inventory and assumed that all particulate sources that were not directly measured contained fluorides ranging between 2% to 3% of TSP for FMC, Simplot, and BAPCO (Bechtel, 1993a; EPA, 1977a).

3.5.1 METHODOLOGY

Information required to calculate the point and area source emission rates were:

- Type of material being processed
- Daily and average annual amount of material being processed (ton/hour, lbs/hour, or tons/year)
- Operational periods in hours per day and/or days per year
- Emission factors: *AP-42*, source emission tests (SET), and/or engineering calculations for process units
- PM_{10} fraction in percentage being applied to the TSP emission rates (for PM_{10} inventory only)
- Capture efficiency of the emission control device expressed as the percent of total uncontrolled emissions
- Control efficiency of the emission control device expressed as the percent control of captured emissions

Uncontrolled, fugitive, and controlled emission rates from point or area sources representing daily and average annual duration were calculated in units of lb/day, ton/yr, and g/s. When the emissions were calculated using source emission test data, all emissions were considered to be controlled. In these cases, uncontrolled and fugitive emissions were back-calculated using estimated capture and collection efficiencies.

Road source inventories were prepared for both PM_{10} and TSP emissions. The road inventory contains emission calculations for light, medium, and heavy vehicle types on unpaved and paved plant roads. Information required to calculate these emissions were:

- Road name or identification number
- Vehicle information: type, number of wheels, vehicle weight in tons, and vehicle speed in miles per hour
- Silt loading on the road
- Distance per trip expressed in ft/day
- Number of days per year the roads are traveled
- Emission factor in pounds per vehicle-mile traveled
- Control efficiency (in percent) of any dust suppressant being applied to the road

Uncontrolled and controlled emissions from the plant roads were calculated representing daily and average annual duration in units of lb/day, ton/yr, and g/s.

Stockpile source inventories were prepared for PM_{10}, TSP, and fluorides. The stockpile inventory includes contributions to fugitive emissions from wind erosion of the piles, loading of materials onto storage piles, and equipment traffic in storage areas. It assumes 8 to 12 hours of activity per 24 hour day. Information required to calculate these emissions were:

- Storage pile name and size of storage pile (square feet)
- *AP-42* emission factors for aggregate handling and storage piles
- Number of days the storage pile is active, broken down into operational periods (hours/day and days/year)
- Type of operations occurring on the stockpile
- Control efficiency (in percent) of any controls being applied to the stockpile
- Percent silt and moisture
- Amount of material handled

- Vehicle traffic on the storage piles
- Dump capacity and drop height of material movers (e.g., front-end loaders)

Uncontrolled and controlled emissions from the stockpiles representing daily and average annual duration were calculated in units of lb/day, ton/yr, and g/s.

3.5.2 DATA LIMITATIONS

The bulk of the information developed for FMC's emission inventories was developed from extensive source test information. Most stack based sources and all large fugitive sources were characterized by recent sources tests (Section 3.3 of this report) or historical source tests. The few remaining sources have been conservatively approximated by engineering calculations, *AP-42* estimates, or engineering judgment and can only approximate current onsite conditions; because of this, some of these sources may be overestimated.

Simplot's point source emission rates were developed using source test information. The source tests usually measured particulate matter emissions, which was TSP. PM_{10} emissions were estimated by using the TSP emission and a percent PM_{10} fraction. Area, road, and stockpile emission rates were developed from engineering calculations and conservative *AP-42* estimates.

3.6 PARTICULATE METALS

The particulate metals inventory includes total phosphorus, total silica, and the following metals: antimony, arsenic, beryllium, cadmium, nickel, lead, and total chromium. The seven metals and total silica were identified as sources of potential risk to human health and were listed as chemicals of potential concern in a proposed Risk Assessment Work Plan for the EMF site (E&E, 1992). Total phosphorus was included because of its association with operations at the facilities. The particulate metals inventory was based on the PM_{10} emission rates and the percent of metal present in the PM_{10} size fraction or source test data (Section 3.3 of this report), when available.

3.6.1 METHODOLOGY

Data from several different sources were combined into a metal inventory. The sources of metal emissions came from source test data, engineering assumptions, or the Pacific Northwest Source Profile Library. Metal emission information for particulate sources was converted to an emission rate for the constituent by multiplying the metal weight fraction by the total PM_{10} emission rate for each source. Sources with specific metal emission rates were placed directly into the inventory and multiplied by the operational time (found in the PM_{10} inventory).

The particulate metal inventory includes listings of all particulate sources at each facility, showing the daily and annual average PM_{10} emission rates (expressed in lb/day and ton/year), the percentage of metal (in PM_{10}) for each source and the source of the metal data and confidence level of the data.

Data sources were identified in the inventory as belonging to one of seven categories:

(A) Indicates constituent data were available in the Pacific Northwest profile library for the emission source.

(B) Indicates data were obtained directly from a source emission test other than the Pacific Northwest Source Profile Library document.

(C) Indicates chemical analysis of material handled (e.g., phosphate ore) without regard to particle size.

(D) Engineering assumptions based on similarity with another source or the fact that the source is directly or partially connected to a known constituent source by process flow.

(E) Superfund Amendments and Re-authorization Act (SARA) Title 3 inventory.

(F) No data for estimation; emissions assumed negligible.

(NE) In some cases, sources without species information were assumed to have no (negligible) emissions of metals and designated as "NE" in the inventory. These sources include:

— FMC and Simplot natural gas-fired boilers – The Companies determined that these units were not plausible candidates for the emission of any metals. The feed to these units consists only of natural gas (fuel) and water (de-mineralized boiler feed water). Neither of the materials would be reasonably suspected to contain any metal constituents of potential concern. Therefore, these sources were considered to be 'non-sources' (negligible) of emission for the specified metals.

— Simplot ammonium sulfate product – This product contains no known source of metals or radionuclides. It is crystalline in form and is produced from ammonia, high purity sulfur, water (demineralized boiler feed water), and AMSOX liquor. Therefore, this source was considered to be a 'non-source' (negligible) of emission for the specified metals.

— FMC silica handling – Since this is a stockpiled raw material, it has been assumed that the primary emission from this source is total silica, and that any other constituent should be negligible.

— Simplot ammonia plants – The feed to the ammonia plants consist of only natural gas (fuel), air, and water (demineralized boiler feed water). None of these materials would be reasonably suspected of containing any of the metal constituents of potential concern. The primary emission point for the process is the natural gas-fired reformer furnace, which should be expected to have emissions similar to other gas-fired equipment. Therefore, these sources were considered to be 'non-sources' (negligible) emissions for the specified metals.

— Simplot sulfuric acid plants – The feed stocks to the sulfuric acid plants consist of only high purity sulfur (fuel), air, and water (demineralized boiler feed water). None of these materials would be reasonably suspected of containing any of the

metal constituents of potential concern. Therefore, these sources were considered to be 'non-sources' (negligible) emissions for the specified metals.

— Simplot nitric acid plant – The feeds to the nitric acid plant consist of only high ammonia (fuel), air, and water (demineralized boiler feed water). None of these materials would be reasonably suspected of containing any of the metal constituents of potential concern. Therefore, these sources were considered to be 'non-sources' (negligible) emissions for the specified metals.

— Simplot superphosphoric acid (SPA) vent – This process consists of water removal from lower-grade phosphoric acid feed stock by heating the feed stock under vacuum with steam (indirect heating) to vaporize the water. The water vapor condenses in non-contact barometric condensers to maintain the required vacuum. None of the metal constituents of potential concern are known to be volatile at the temperatures encountered in the condenser. Therefore, these sources were considered to be 'non-sources' (negligible) emissions for the specified metals.

— Simplot UAN32 vent – Urea-ammonium nitrate solution is prepared by neutralizing an aqueous solution of ammonia with nitric acid and adding an urea solution to the mixture. There are no metals of potential concern in any of the feed stocks. Therefore, these sources were considered to be 'non-sources' (negligible) emissions for the specified metals.

The Pacific Northwest Profile Library (Core, 1989) provided data for sources without recent site-specific data. This library has compiled upgraded information on particulate matter sizes and on the emissions of 74 inorganic and organic chemicals for different types of industrial, commercial, and residential sources in the Pacific Northwest. This source information is available for receptor modeling. When the Pacific Northwest profiles (source emissions) were used, the higher of the fines/PM_{10} value listed in the profile was used to calculate constituent emissions.

As a result of the additional source characterization efforts by both FMC and Simplot, most sources previously characterized in the 1992 inventory by means of PNPL data have been updated. The only exceptions to this are:

- Antimony, silica, and phosphorus emissions from the FMC calciner.

- Simplot calciner emissions. Please note that this source is no longer operational, was not in operation during the CERCLA monitoring period, and was not considered in modeling.
- Simplot unpaved roads.

Facility specific assumptions are provided in Sections 3.6.3, 3.6.4, and 3.6.5 for FMC, Simplot, and BAPCO, respectively.

3.6.2 DATA LIMITATIONS

There are a number of data limitations which affect the speciated inventory for both facilities. These include:

- The Pacific Northwest Source Profiles provide only PM_{10} speciated data, not TSP; therefore, particulate metal concentrations could not be developed for TSP-based emissions.
- Speciated profiles list elemental metal and non-metal compounds. Metal compounds may exist in the particulate and may be considered toxic by the air pathway. Some metal compounds may also have been converted to the oxide form during laboratory analysis and may overestimate the metals content of particulate matter.
- Chromium values listed in the Pacific Northwest Source Profile Library tables and on source tests are total chromium (Cr^{+6}, Cr^{+3}, and others), unless otherwise noted in the previous discussion of additional source characterizations.
- Site-specific metal information about the BAPCO facility was not available; therefore, the characteristics of these metals found in FMC slag and coke source tests were used to estimate emission rates from BAPCO's sources.
- Although beryllium was listed in the E&E Work Plan (E&E, 1992) as a constituent of potential concern, beryllium data was not available in the Pacific Northwest Profiles. At FMC, beryllium was analyzed in the calciner stack, furnace tap hood vent stack and fugitives, and in fugitive dust material (shale ore, calciner fines, baghouse fines, coke, and slag) tests. At Simplot, beryllium was analyzed in all of the source tests but it was not detected.

3.6.3 FMC FACILITY ASSUMPTIONS

FMC sources for which source test data were available were: slag pit and pile; tap hood fugitives, paved and unpaved roads, coke handling, calciner fines, baghouse dust pile, calciner scrubber stacks, and ore handling.

For sources where no speciation information was available, the following assumptions were made:

- The calciner coolers, discharge baghouses, nodule baghouses (including the stockpile and fines stockpile), and the burden baghouses emission's metal content were assumed to be the same as the calciner fines sample.
- CO flares and secondary condenser flare – particulate matter from these sources (as total phosphorus) was estimated from a mass balance analysis prepared by FMC (FMC, 1995). The metals content of the gas streams was based on impurities in the P_4 product.
- Furnace pressure relief vents – particulates from these sources was also based on the FMC mass balance.
- Beryllium content in PM_{10} for all sources was based on chemical analysis of the basic materials handeled at the FMC facility. In the past, the beryllium content for PM_{10} sources was asumed to be the same as that found in phosphate ore (about 1 ppm).

Additional chemical analysis data were taken from available FMC reference material (DOI, 1977; Holmes, 1985; Lombardo, 1985; and Chester, 1993, 1994a, -b, and -c).

3.6.4 SIMPLOT FACILITY ASSUMPTIONS

Simplot's source tests include: paved road dust; gypsum pile; Granulation #1, #2, and #3, the cooling towers, and the #400 phosphoric acid plant. For sources without available constituent information, the following assumptions were made:

- Profiles for the granulation area and fugitive sources were assumed to be the same as the granulation stack profiles.
- Phosphoric acid plant process fugitive and area sources were assumed to be the same as the phosphoric acid stack profile.

- For unpaved roads, the highest value listed in the Pacific Northwest Profile Library table was used to calculate constituent emissions.

3.6.5 BAPCO FACILITY ASSUMPTIONS

Because there were no metal source test data in the BAPCO inventory published by the state of Idaho, source test data on metals in FMC's slag and coke were used to characterize emissions from slag and coke handling at BAPCO. The unpaved roads at BAPCO were assumed to be similar to FMC's road 5, which connects the slag pile with the Kinport Station and passes through the FMC ponds area. The paved roads were assumed to be similar to FMC's road 11, which leads from FMC's slag pit to the BAPCO facility.

3.7 RADIONUCLIDES

The radionuclide inventory includes the following radionuclides: lead-210; polonium-210; radium-228, -226; thorium-230, -232; and uranium-238, -234, and -235. These nine radionuclides were evaluated by EPA to assess the impact on public health (EPA, 1978a and 1978b. The facilities radionuclide inventory was based on studies performed by EPA (EPA, 1978a, 1978b, 1990a) and facility source tests.

Ore, the primary feed material in both FMC and Simplot operations, contains 20 to 200 parts per million (ppm) uranium, which is 10 to 100 times greater than uranium concentrations found in typical rock and soil (EPA, 1989d). In the production of elemental phosphorus at FMC, the rock is heated in the calciners to high temperatures, volatilizing lead-210 and polonium-210. In the production of phosphoric acid at Simplot, a selective separation and concentration of radionuclides occurs. Eighty-six per cent of the uranium is found in the phosphoric acid product, while about 80% of the radium-226, the parent nuclide of radon-222, is found in the by-product phosphogypsum (EPA, 1975).

3.7.1 METHODOLOGY

Radionuclide emission information for particulate sources was converted to an emission rate for the radionuclide by multiplying the radionuclide fraction by the total PM_{10} emission rate for each source. Sources with specific radionuclide emission rates were placed directly into the inventory and multiplied by the operational time (found in the PM_{10} inventory).

The PM_{10} emission rates were used because the EPA reports state that more than 50 percent of the total radioactivity present is associated with the particle-size fraction of less than one micrometer (μm) in diameter, and that approximately 80% is associated with the particle-size fraction of less than 7.5 μm (EPA, 1978b).

The radionuclide inventory includes listings of all particulate sources for each facility, showing the daily and annual average PM_{10} emission rates in lb/day and ton/year; the activity percentage of the radionuclide for each source in pCi/g; and the resulting emission rate in pCi/s for each source.

3.7.2 DATA LIMITATIONS

There are a number of data limitations which affect the speciated inventory for both facilities. These include:

- Not all sources were tested for all radionuclides at the facilities.
- Several of the sources tested by the EPA are not in operation at this time. The non-operational source emissions stated in the EPA reports were applied to similar operational processes.
- As stated in the EPA reports conducted in 1977 and 1978, the polonium-210 and lead-210 emissions could be understated as much as five times or more. However, recent source test data for polonium-210 for the FMC calciners were used, rather than the EPA data for this source.
- BAPCO's radionuclide emissions were assumed to be similar to those associated with similar materials and activities at FMC (i.e., slag and coke).

Modeling Methodology

This section describes the methodology used to estimate ambient constituent concentrations associated with emissions from the FMC, Simplot, and BAPCO facilities. The modeling methodology followed the guidelines found in the EPA's *Guideline on Air Quality Models (revised)*, (EPA, 1986a) and *Supplement B to the Guideline on Air Quality Models (revised)*, (EPA, 1990c). Further information on the modeling methodology is found in the EMF RI Work Plan (Bechtel, 1992a).

Revisions to Modeling Methodology Since Last Report

Since the *September 1994 Ambient Air Quality Characterization Report* for the EMF study area (Bechtel, 1994k), a number of changes were made to the modeling methodology. These changes were as follows:

- By agreement with the EPA, IDEQ, and Shoshone-Bannock tribes, deposition modeling (if needed) as detailed in the RI/FS work plan, was deferred to the FS portion of the study.
- A set of case studies were performed to further evaluate model performance. These are presented in Appendix AJ.
- A revision of the EPA's building downwash factor estimation program BPIP was used.
- A revised set of mixing height data was used to characterize local dispersion conditions.
- A dense grid of receptors was added around the three closest monitoring sites to better evaluate model performance.

4.1 OBJECTIVES AND APPROACH

The objective of the modeling study was to characterize the effects of emissions from FMC, Simplot, and BAPCO sources on ambient air quality coincident with the period of operation at the seven-station EMF air monitoring network. The accuracy and representativeness of the model (and related emission inventories) were evaluated by comparing average annual and daily predictions with the monitoring data. Two sets of model output were obtained:

- Average annual constituent concentrations, based on average annual emissions from the facilities. A one-year period was modeled: October 1, 1993 through September 30, 1994.
- Twenty-four-hour constituent concentrations, based on typical daily emissions during this period, to assess model performance. The daily emission rate reflects operation of each source at typical production rates or a representative material throughput rate.

The diversity of sources present at the facilities, combined with locally elevated terrain and complex meteorology, required a modeling approach using a combination of three air dispersion models. None of the models, in isolation, were applicable to all of the sources or terrain. These models predict concentrations for various time-averaging periods from daily to average annual concentrations.

Ground-level elevations within the study area range from at- or below- emission release elevation to above-final plume height. Because of this range, concentrations were predicted for three types of receptors:

- Simple Terrain Receptors–defined as ground-level receptors at elevations lower than the elevation of the release point,
- Intermediate Terrain Receptors–defined as ground-level receptors at elevations higher than or equal to that of the release point, but with elevations lower than or equal to the final plume height, and
- Complex Terrain Receptors–defined as ground-level receptors at elevations greater than the final plume height.

The Industrial Source Complex-Short Term 2 (ISCST2 version 93109) modeled point sources (i.e., stacks and process vents with potentially buoyant plumes) with receptors located in simple terrain. The COMPLEX-I model (version 90005) modeled point sources with receptors located in complex terrain. Point sources with receptors located in intermediate terrain were modeled using both ISCST2 and COMPLEX-I; the higher predicted concentration was used in the modeling study. Further discussion of ISCST2 and COMPLEX-I, and of intermediate terrain modeling is presented in Sections 4.4 and 4.5.1, respectively.

The EPA's Fugitive Dust Model (FDM version 94040) was used to model sources with non-buoyant plumes (i.e., windblown dust from roads and storage piles) for receptors located in simple terrain. These sources were modeled in FDM as line, area and volume sources. FDM contains a deposition algorithm and an area source algorithm that is considered to be superior to the algorithm found in ISCST2. Unlike ISCST2 and COMPLEX-I, FDM does not contain a plume rise algorithm for buoyant plumes. Therefore, it was more appropriate to model the point sources (i. e., sources with buoyant plumes) with ISCST2 and COMPLEX-I, as mentioned above.

Air stagnation conditions are characterized by calm or very low wind speeds, and variable wind directions. These stagnant meteorological conditions may persist for several days. During stagnation conditions, the dispersion of constituents, especially those from low-level emission sources, tends to be minimized, potentially leading to relatively high, localized, ground-level concentrations. This effect is of potential concern during wintertime in the Pocatello area.

Characterization of ambient air quality during an atmospheric stagnation episode was to be modeled using a fourth model (WYNDvalley) with the results provided in this RI report. This approach was changed, after consultation with EPA, when it was determined that the WYNDvalley model was not appropriate for use at the site. Instead, a representative analysis of air stagnation was performed using the three models discussed above. After discussion with the oversight agencies, one stagnation period was identified for study by modeling (January 18-22, 1994). The results of this analysis are in Appendix AJ.

4.2 METEOROLOGICAL DATA

Two sets of meteorological data were available in the EMF site area. These were once-per-hour observations recorded at the Pocatello Airport by the National Weather Service (NWS) and hourly, averaged observations recorded at two meteorological monitoring sites (Site 1 and Site 7) by Simplot. The Site 1 and Site 7 monitoring sites are within one mile of each other and about four miles from the Pocatello Airport NWS monitoring site. Site 1 is near plant grade level, and Site 7 is 423 feet higher than Site 1 and located on the northern slope of the Bannock Range.

A detailed comparison of the two sets of meteorological data collected in previous years was presented in *Report of the Analysis of Pocatello, Idaho Meteorological Data for Use in Atmospheric Dispersion Modeling* (Bechtel, 1992b). Although EPA Region 10 determined that Simplot's meteorological data would be "...useful as an aid in the selection of potential monitoring locations" (EPA, 1992f), insufficient documentation existed at that time to verify the quality of Simplot's historical data set, which was used in the identification of monitoring site locations for ambient air monitoring at the EMF site (Bechtel, 1993a).

For this current study, a high-quality meteorological data set was required to meet CERCLA data quality objectives (DQO), and to evaluate model performance in the study area. Based on previous studies, the Simplot Site 1 meteorological monitoring site was chosen as the most representative meteorological monitoring site. Data recorded at this site between October 1, 1993 through September 30, 1994 were used in the modeling study. This period was coincident with the operation of the seven, ambient air sampling sites for the EMF study area. These meteorological data were subjected to CERCLA DQO standards to produce a concurrent meteorological data set of a known quality. Monthly summaries of these data are presented in Appendix AC-1 through AC-3.

Meteorological data recovery rates for the entire year of monitoring were at, or near, 100 percent for most parameters measured, with brief periods of missing or invalid data. Since atmospheric dispersion models require a complete set of meteorological data (i.e., no data gaps), these brief

periods of missing data were spanned by linear interpolation. On two occasions (October 18 and 19, 1993 and January 26 and 27, 1994) interpolation of the missing data could not reasonably span these gaps. To fill these gaps, the missing meteorological data was made by substituting data for these days taken at the NWS station at Pocatello Airport. This process was consistent with the procedure identified in the *Meteorological Data Acquisition Plan for the Eastern Michaud Flats Site* (Bechtel, 1994i). In the case of October 18 and 19, only stability data were needed; these were derived from the NWS data using the traditional "Turner" method (Turner, 1970). For January 26 and 27, all parameters were needed to replace missing data.

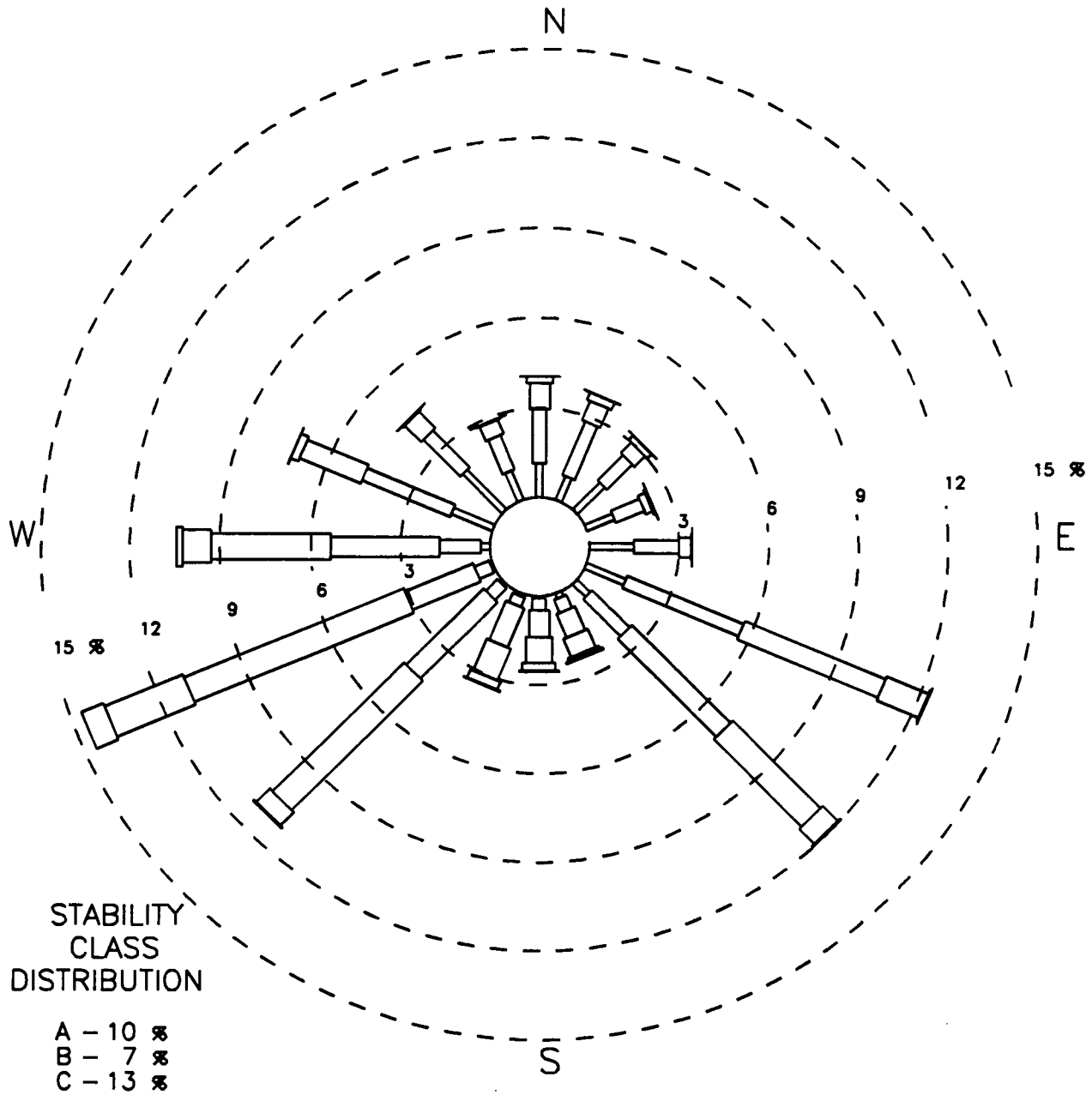
Wind data for the 1993-1994 period are summarized in Figures 4.2-1, 4.2-2, and 4.2-3 in the form of wind roses. Shown in Figure 4.2-1, the predominant wind direction is SW to WSW, with a secondary prevailing southeasterly wind.

An acoustic sounder was operated as part of the sensor array at Site 1. This instrument provides local measurement of mixing height (the height of the "mixed layer") to 1000 meters. Details of this monitoring system may be found in *Meteorological Data Acquisition Plan for the Eastern Michaud Flats Site* (Bechtel 1994i), and in other reports (Bechtel, 1993b and 1993c and Bechtel, 1994e and 1994f).

Mixing height data derived from acoustic sounders is often subject to varying interpretation. Because the data are collected by remote sensing, it is difficult to accurately calibrate the information, and a characterization scheme is needed to interpret the data. During sensitivity evaluations of model performance, subsequent to the September 1994 modeling report (Bechtel, 1994k), analysis suggested that the initial characterization scheme used to determine mixing height produced unrealistically low mixing heights during neutral (stability class D) and unstable (stability class A, B, or C) atmospheric conditions. During these neutral and unstable conditions, mixing height (the height of the "mixed layer") should be significantly elevated due to mechanical and thermal turbulence within the planetary boundary layer (typically from the surface to 1 km). After a review of published literature, discussions with the instrument

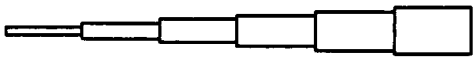
manufacturer, and subsequent discussions with the EPA, the existing mixing height characterization scheme was modified for modeling purposes. These modifications were:

- The maximum mixing height for any observation was limited to 1500 meters above ground surface, which is a reduction from the originally estimated 5000-meter height. The correction was based on the limits of the instrument and typical default values for unknown or unlimited mixing height. However, this change had no effect on the model predicted data results.
- When atmospheric stability was unstable or neutral, mixing heights based on the characterization scheme of less than 100 meters were set equal to 125 times the wind speed (Benkley and Schulman, 1979). This factor (125) was used to model the influence of varied mixing heights as a function of wind speed. The prior approach set a mixing height to a single large value (such as 1,500 meters). An evaluation of this revised mixing height data indicated that the original mixing height characterization scheme tended to "trap" emitted plumes below the lowest mixing height (typically 40 to 50 meters). This unrealistically concentrated airborne constituents when model predictions were compared with ambient monitoring data. The revised mixing height data corrects this simulation problem and results in better estimation of stack-based sources within the EMF study area.



STABILITY CLASS DISTRIBUTION

A – 10 %
B – 7 %
C – 13 %
D – 53 %
E – 7 %
F – 10 %



0–3 (13 %) 4–6 (23 %) 7–10 (29 %) 11–16 (28 %) 17–21 (6 %) 22–99 (1 %)

WIND SPEED SCALE (KNOTS)

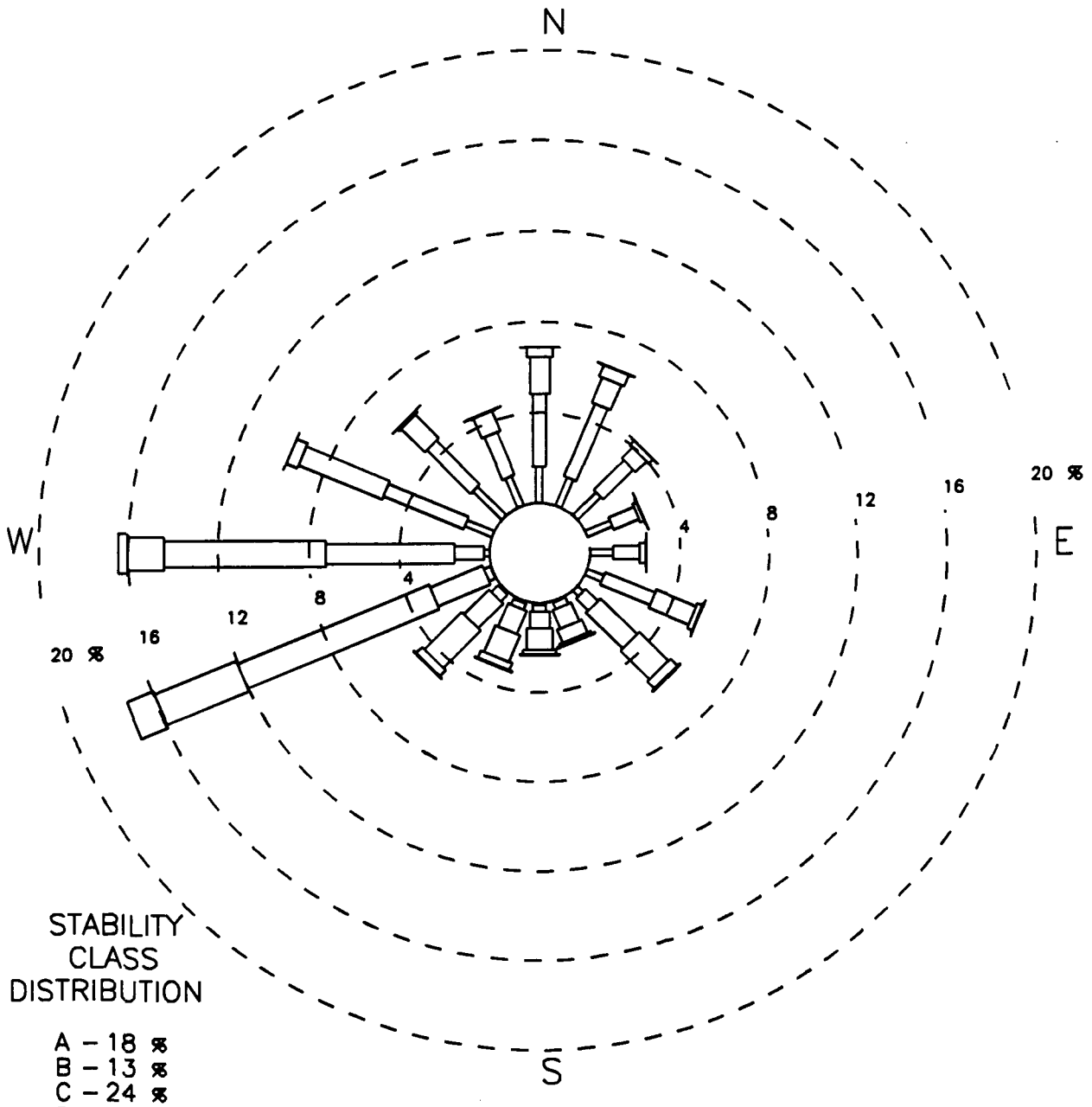
NOTE – WIND DIRECTION IS THE DIRECTION WIND IS BLOWING FROM

Site 1 Wind Direction

October 1993 to September 1994

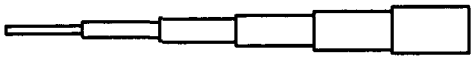
Calms 3.3%

Figure 4.2–1



STABILITY CLASS DISTRIBUTION

A – 18 %
B – 13 %
C – 24 %
D – 42 %
E – 1 %
F – 2 %

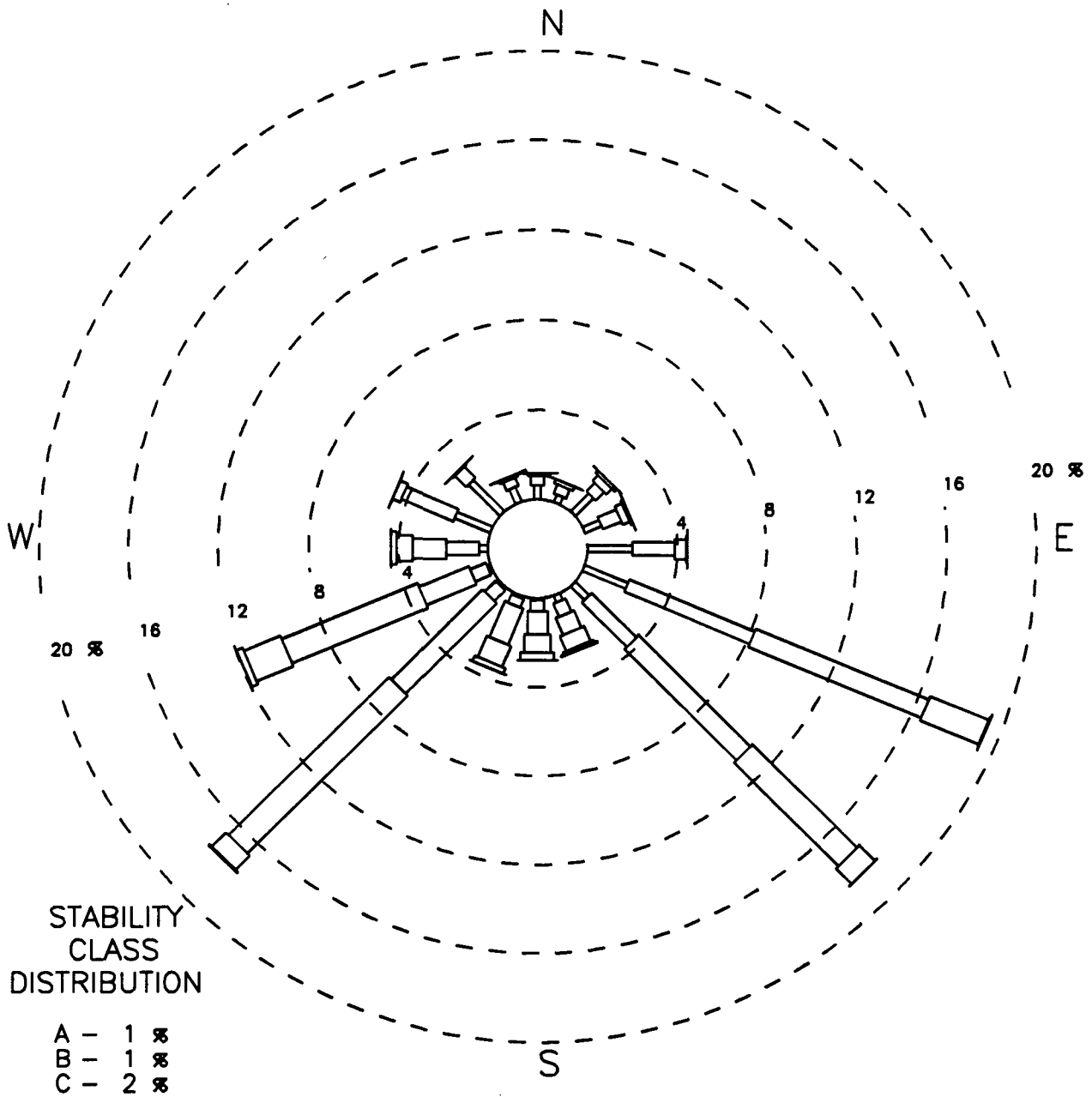


0–3 (13 %) 4–6 (26 %) 7–10 (27 %) 11–16 (26 %) 17–21 (7 %) 22–99 (2 %)

WIND SPEED SCALE (KNOTS)

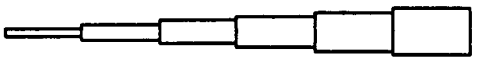
NOTE – WIND DIRECTION IS THE DIRECTION WIND IS BLOWING FROM

Site 1 Wind Direction
(Daytime Hours Only)
October 1993 to
September 1994
Calms 2.6%
Figure 4.2–2



STABILITY CLASS DISTRIBUTION

A – 1 %
B – 1 %
C – 2 %
D – 64 %
E – 14 %
F – 18 %



0–3 (13 %) 4–6 (21 %) 7–10 (31 %) 11–16 (30 %) 17–21 (5 %) 22–99 (0 %)

WIND SPEED SCALE (KNOTS)

NOTE – WIND DIRECTION IS THE DIRECTION WIND IS BLOWING FROM

Site 1 Wind Direction
(Nighttime Hours Only)
October 1993 to
September 1994
Calms 4.1%
Figure 4.2–3

4.3 AMBIENT AIR MONITORING DATA

Ambient air monitoring was conducted at seven sites within the EMF study area during the period October 1, 1993 through October 31, 1994. Locations of these monitoring sites are shown on Figure 1.1-1. Sample analysis was conducted for gravimetric-based constituents (PM_{10} and TSP) every other day, while chemical and radiological constituents were analyzed at least every fourth day between October 1993 through March 1994. This period was chosen after review of historical data, which indicated that the highest levels of airborne constituents were typically observed during the fall and winter seasons. Per agreement with EPA Region 10, routine chemical and radiological constituent analyses were discontinued after March 30, 1994. However, samples continued to be analyzed for gravimetric parameters (PM_{10}, TSP and monthly lo-vols) until October 31, 1994. Samples from three days (April 14, June 7, and September 21) were subsequently analyzed for inorganic and radiological constituents for use in case studies.

Data from these sites provide a high quality data set for use in evaluating model performance over the region. These data are presented in the *EMF Ambient Air Monitoring Report* (Part III, Volume 1) and will not be presented here except in statistical tabular form. Table 4.3-1 presents such information for metals and other inorganic constituents (silica and fluorides) and Table 4.3-2 presents similar data for radionuclides.

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TABLE 4.3-1
Basic Statistics for Monitored Inorganics
October 1993 through October 1994

Site	Type	Statistic	Particulate	Al	As	Ba	Be	Cd	Total Cr	F (total)	Mn	Ni	P	Se	Si	Ag	Tl	V	Zn
1	PM_{10}	Maximum	79.5	0.68	2.75E-03	2.29E-02	1.77E-04	1.24E-02	4.02E-02		2.64E-02	6.61E-03	6.22	2.14E-02		< 1.2E-3	< 3.3E-2	4.28E-02	0.19
		Minimum	4.1	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4		1.84E-03	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	6.11E-03
		Average	30.2	0.15	6.53E-04	4.75E-03	< 1.7E-4	2.60E-03	3.96E-03		6.45E-03	3.48E-03	1.00	1.68E-02		< 1.2E-3	< 3.3E-2	1.92E-04	2.18E-02
		Std. Dev.	12.6	0.14	5.75E-04	4.32E-03	1.79E-06	2.47E-03	7.50E-03		5.08E-03	5.64E-04	1.31	8.29E-04		0.00	6.69E-10	7.62E-03	2.73E-02
		Num. of Obs.	193	32	50	32	32	50	50	NM	32	37	50	32	NM	32	32	50	50
	TSP	Maximum	218.7	2.40	2.87E-03	3.33E-02	3.01E-04	1.87E-02	0.25	13.14	5.34E-02	4.46E-02	8.81	2.86E-02	84.1	1.31E-03	< 3.3E-2	0.25	0.15
		Minimum	15.0	0.09	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4	< 1.3	4.64E-03	< 3.3E-3	< 0.2	< 1.7E-2	10.5	< 1.2E-3	< 3.3E-2	< 1.7E-3	1.30E-02
		Average	60.3	0.42	6.56E-04	9.36E-03	1.77E-04	3.23E-03	1.13E-02	2.28	1.23E-02	4.39E-03	0.62	1.71E-02	26.2	< 1.2E-3	< 3.3E-2	1.14E-02	3.45E-02
		Std. Dev.	29.0	0.48	6.53E-04	7.17E-03	3.36E-05	3.76E-03	3.82E-02	2.80	1.10E-02	6.90E-03	1.71	2.03E-03	17.0	2.31E-05	0.00	3.77E-02	2.31E-02
		Num. of Obs.	197	37	57	37	37	57	57	65	37	40	57	37	49	37	37	57	57
2	PM_{10}	Maximum	150.7	0.77	4.61E-03	1.86E-02	2.71E-04	5.60E-02	1.19E-01		2.33E-02	2.25E-02	19.11	0.12		5.07E-03	< 3.3E-2	1.26E-01	0.42
		Minimum	6.6	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4		2.27E-03	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	1.50E-02
		Average	56.5	0.33	1.27E-03	7.48E-03	1.79E-04	1.16E-02	1.74E-02		1.08E-02	4.85E-03	5.45	2.90E-02		1.62E-03	< 3.3E-2	1.93E-02	7.85E-02
		Std. Dev.	26.3	0.22	9.97E-04	3.96E-03	2.60E-05	1.18E-02	2.20E-02		5.49E-03	3.35E-03	5.10	2.38E-02		9.38E-04	6.69E-10	2.47E-02	7.67E-02
		Num. of Obs.	193	32	50	32	32	50	50	NM	32	38	50	32	NM	32	32	50	50
	TSP	Maximum	442.6	3.64	6.60E-03	4.51E-02	4.30E-04	6.91E-02	0.75	11.29	8.16E-02	0.13	26.81	0.11	325.0	7.41E-03	5.41E-02	0.80	0.48
		Minimum	27.5	0.28	2.50E-04	6.13E-03	< 1.7E-4	< 1.3E-3	7.38E-03	< 1.3	8.09E-03	< 3.3E-3	< 0.2	< 1.7E-2	14.5	< 1.2E-3	< 3.3E-2	6.59E-03	2.64E-02
		Average	137.1	1.26	1.78E-03	1.96E-02	2.22E-04	1.57E-02	5.16E-02	2.56	2.95E-02	1.13E-02	5.90	2.38E-02	52.1	1.60E-03	3.40E-02	6.10E-02	1.16E-01
		Std. Dev.	70.6	0.90	1.46E-03	9.76E-03	6.68E-05	1.53E-02	1.09E-01	2.05	1.78E-02	2.08E-02	6.11	2.28E-02	56.4	1.25E-03	3.80E-03	1.15E-01	9.60E-02
		Num. of Obs.	191	36	58	36	36	58	58	67	36	41	58	36	43	36	36	58	58
3	PM_{10}	Maximum	67.4	0.34	3.39E-03	5.55E-03	< 1.7E-4	3.63E-03	4.97E-03		1.11E-02	3.70E-03	1.53	1.99E-02		< 1.2E-3	4.34E-02	4.49E-03	2.40E-02
		Minimum	1.5	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4		1.51E-03	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	21.3	0.09	5.63E-04	3.14E-03	< 1.7E-4	1.68E-03	9.25E-04		4.99E-03	3.36E-03	0.31	1.69E-02		1.17E-03	3.39E-02	1.98E-03	1.33E-02
		Std. Dev.	9.3	0.08	6.24E-04	1.18E-03	4.60E-12	6.46E-04	1.27E-03		2.28E-03	9.07E-05	0.50	7.02E-04		0.00	2.28E-03	7.11E-04	6.75E-03
		Num. of Obs.	143	31	46	31	31	46	46	NM	31	36	46	31	NM	31	31	46	46
	TSP	Maximum	261.1	1.94	3.39E-03	2.88E-02	2.40E-04	4.63E-03	3.47E-02	2.17	6.79E-02	6.71E-03	2.88	3.29E-02		< 1.2E-3	3.57E-02	3.69E-02	4.11E-02
		Minimum	5.5	0.10	< 1.7E-4	< 1.7E-3	< 1.7E-4	1.23E-03	< 1.7E-4	< 1.3	4.84E-03	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	50.5	0.30	5.23E-04	5.58E-03	1.69E-04	1.98E-03	3.38E-03	1.48	1.07E-02	3.58E-03	< 0.2	1.74E-02		< 1.2E-3	3.34E-02	4.30E-03	1.84E-02
		Std. Dev.	28.5	0.39	6.72E-04	5.45E-03	1.28E-05	1.06E-03	6.65E-03	0.27	1.22E-02	6.56E-04	0.73	3.06E-03		1.43E-11	4.18E-04	7.03E-03	9.11E-03
		Num. of Obs.	149	34	55	34	34	55	55	55	34	39	55	34	NM	34	34	55	55
	Lo-vol	Maximum	202.0	18.36	8.24E-03	2.08E-01	9.38E-04	1.18E-02	4.01E-02		0.56	2.10E-02	4.98	< 1.9E-2		< 1.3E-3	< 3.7E-2	3.97E-02	0.19
		Minimum	29.2	0.17	4.93E-04	5.86E-03	< 1.9E-4	< 1.5E-3	1.13E-03		7.37E-03	< 3.7E-3	0.55	< 1.9E-2		< 1.3E-3	1.35E-02	3.30E-03	1.57E-02
		Average	66.5	0.94	8.05E-04	1.96E-02	< 1.9E-4	2.96E-03	5.64E-03		3.75E-02	4.46E-03	0.83	< 1.9E-2		< 1.3E-3	2.88E-02	6.71E-03	2.67E-02
		Std. Dev.	79.9	8.96	2.41E-03	9.92E-02	4.14E-04	3.14E-03	1.15E-02		0.27	9.14E-03	1.36	0.00		4.09E-04	1.17E-02	1.10E-02	5.48E-02
		Num. of Obs.	10	4	10	4	4	10	10	NM	4	4	10	4	NM	4	4	10	10
4	PM_{10}	Maximum	72.7	0.76	3.00E-03	1.72E-02	< 1.7E-4	6.13E-03	7.04E-03		2.44E-02	3.81E-03	0.34	1.81E-02		1.46E-03	3.80E-02	3.06E-03	3.08E-02
		Minimum	2.1	< 0.01	< 1.7E-4	< 1.7E-3	1.57E-04	1.32E-03	< 1.7E-4		< 5.0E-4	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	23.0	0.11	6.17E-04	4.14E-03	< 1.7E-4	1.48E-03	9.38E-04		6.44E-03	3.34E-03	< 0.2	1.68E-02		< 1.2E-3	3.34E-02	1.80E-03	1.27E-02
		Std. Dev.	11.1	0.15	6.32E-04	3.12E-03	1.65E-06	6.99E-04	1.39E-03		4.45E-03	8.23E-05	0.05	2.54E-04		0.00	8.66E-04	2.88E-04	7.50E-03
		Num. of Obs.	180	33	50	33	33	50	50	NM	33	38	50	33	NM	33	33	50	50
	TSP	Maximum	161.3	1.65	3.55E-03	2.69E-02	2.81E-04	6.92E-03	1.12E-02	3.25	4.60E-02	4.66E-03	1.94	2.10E-02		< 1.2E-3	< 3.3E-2	1.04E-02	6.16E-02
		Minimum	5.5	0.08	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4	1.33	3.14E-03	< 3.3E-3	< 0.2	1.63E-02		< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	46.1	0.34	5.80E-04	6.56E-03	1.74E-04	1.68E-03	2.28E-03	1.54	1.23E-02	3.44E-03	< 0.2	1.69E-02		< 1.2E-3	< 3.3E-2	3.46E-03	2.01E-02
		Std. Dev.	25.5	0.37	7.32E-04	6.55E-03	2.67E-05	9.77E-04	2.77E-03	0.40	1.07E-02	3.08E-04	0.41	1.00E-03		2.74E-11	0.00	2.19E-03	1.14E-02
		Num. of Obs.	183	37	58	37	37	58	58	58	37	41	58	37	NM	37	37	58	58
	Lo-vol	Maximum	106.6	3.88	5.30E-03	6.90E-02	1.85E-04	7.57E-03	1.71E-02		0.11	7.88E-03	3.49	< 1.9E-2		< 1.3E-3	< 3.7E-2	1.62E-02	0.13
		Minimum	29.8	0.21	4.69E-04	6.72E-03	< 1.9E-4	< 1.5E-3	2.73E-03		9.60E-03	< 3.7E-3	< 0.2	< 1.9E-2		< 1.3E-3	< 3.7E-2	2.07E-03	1.47E-02
		Average	52.0	0.58	7.99E-04	1.41E-02	< 1.9E-4	2.40E-03	4.62E-03		2.30E-02	< 3.7E-3	0.42	< 1.9E-2		< 1.3E-3	< 3.7E-2	3.99E-03	2.50E-02
		Std. Dev.	56.2	1.78	1.34E-03	3.03E-02	3.60E-05	2.46E-03	4.12E-03		5.01E-02	3.21E-03	0.91	0.00		4.33E-04	0.00	3.98E-03	3.10E-02
		Num. of Obs.	12	4	12	4	4	12	12	NM	4	4	12	4	NM	4	4	12	12
5	PM_{10}	Maximum	90.8	0.32	2.36E-03	5.09E-03	< 1.7E-4	1.04E-02	6.00E-02		1.12E-02	3.65E-03	2.08	2.24E-02		1.38E-03	< 3.3E-2	6.13E-02	4.24E-02
		Minimum	0.2	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4		5.92E-04	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	18.5	0.09	5.50E-04	2.46E-03	< 1.7E-4	2.19E-03	2.21E-03		3.59E-03	3.34E-03	0.47	1.69E-02		< 1.2E-3	3.33E-02	3.25E-03	9.84E-03
		Std. Dev.	12.0	0.09	5.74E-04	1.03E-03	3.89E-12	1.99E-03	8.73E-03		2.82E-03	5.48E-05	0.65	1.06E-03		0.00	1.96E-05	8.67E-03	8.10E-03
		Num. of Obs.	176	29	47	29	29	47	47	NM	29	35	47	29	NM	29	29	47	47
	TSP	Maximum	167.8	1.97	3.90E-03	2.44E-02	2.93E-04	1.50E-02	2.49E-01	3.33	7.06E-02	4.57E-02	2.99	2.63E-02		6.02E-03	< 3.3E-2	0.26	0.07
		Minimum	1.5	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4	1.33	7.65E-04	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	33.0	0.19	4.85E-04	4.64E-03	1.74E-04	2.12E-03	1.57E-03	1.59	7.07E-03	3.80E-03	< 0.2	1.71E-02		1.26E-03	< 3.3E-2	4.15E-03	1.49E-02
		Std. Dev.	26.6	0.40	7.35E-04	4.90E-03	2.70E-05	2.86E-03	3.41E-02	0.49	1.41E-02	6.95E-03	0.88	1.77E-03		8.61E-04	6.69E-10	3.50E-02	1.40E-02
		Num. of Obs.	177	32	53	32	32	53	53	53	32	37	53	32	NM	32	32	53	53
	Lo-vol	Maximum	92.5	2.32	3.30E-03	3.28E-02	4.98E-04	1.99E-02	1.61E-02		6.34E-02	1.06E-02	4.84	< 1.9E-2		< 1.3E-3	< 3.7E-2	1.78E-02	7.19E-02
		Minimum	27.4	0.16	4.45E-04	< 1.9E-3	< 1.9E-4	< 1.5E-3	2.66E-03		5.11E-03	< 3.7E-3	0.50	< 1.9E-2		< 1.3E-3	< 3.7E-2	3.22E-03	1.03E-02
		Average	48.1	0.46	6.89E-04	6.94E-03	< 1.9E-4	3.79E-03	6.54E-03		1.47E-02	< 3.7E-3	0.97	< 1.9E-2		< 1.3E-3	< 3.7E-2	6.67E-03	1.80E-02
		Std. Dev.	51.6	1.02	8.25E-04	1.42E-02	1.87E-04	5.66E-03	4.44E-03		2.71E-02	4.30E-03	1.22	0.00		0.00	0.00	5.08E-03	1.74E-02
		Num. of Obs.	11	4	11	4	4	11	11	NM	4	4	11	4	NM	4	4	11	11
6	PM_{10}	Maximum	105.6	2.01	3.75E-03	1.88E-02	< 1.7E-4	1.95E-03	3.72E-03		5.22E-02	< 3.3E-3	0.78	< 1.7E-2		< 1.2E-3	3.37E-02	5.29E-03	1.75E-02
		Minimum	0.2	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4		7.05E-04	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	19.8	0.15	5.02E-04	2.93E-03	< 1.7E-4	1.35E-03	2.75E-04		5.34E-03	3.33E-03	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	1.77E-03	5.18E-03
		Std. Dev.	11.6	0.36	6.33E-04	3.10E-03	5.23E-12	9.43E-05	5.10E-04		9.41E-03	2.06E-05	0.14	4.10E-10		0.00	7.78E-05	5.49E-04	3.95E-03
		Num. of Obs.	197	32	51	32	32	51	51	NM	32	38	51	32	NM	32	32	51	51
	TSP	Maximum	293.0	4.12	3.87E-03	4.06E-02	2.60E-04	2.02E-03	7.30E-03	2.83	1.03E-01	3.79E-03	2.82	1.91E-02	76.2	< 1.2E-3	4.49E-02	8.32E-03	3.73E-02
		Minimum	2.3	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4	< 1.3	1.19E-03	< 3.3E-3	< 0.2	< 1.7E-2	< 3.5	< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	32.0	0.10	3.89E-04	3.82E-03	1.70E-04	1.37E-03	2.68E-04	< 1.3	5.92E-03	3.34E-03	< 0.2	1.68E-02	20.7	< 1.2E-3	3.36E-02	1.86E-03	5.32E-03
		Std. Dev.	31.2	0.71	6.74E-04	7.14E-03	1.62E-05	1.54E-04	1.35E-03	0.54	1.88E-02	7.23E-05	0.39	4.01E-04	21.7	2.74E-11	1.91E-03	1.12E-03	6.44E-03
		Num. of Obs.	195	37	58	37	37	58	58	65	37	41	58	37	45	37	37	58	58
	Lo-vol	Maximum	142.4	2.69	3.47E-03	3.97E-02	< 1.9E-4	2.47E-03	6.55E-03		0.09	7.32E-03	0.78	< 1.9E-2		< 1.3E-3	< 3.7E-2	7.90E-03	3.68E-02
		Minimum	8.8	0.06	2.77E-04	< 1.9E-3	< 1.9E-4	< 1.5E-3	< 1.9E-4		3.15E-03	< 3.7E-3	< 0.2	< 1.9E-2		< 1.3E-3	< 3.7E-2	< 1.9E-3	4.54E-03
		Average	36.7	0.29	5.69E-04	6.45E-03	< 1.9E-4	1.14E-03	1.02E-03		1.21E-02	< 3.7E-3	0.09	< 1.9E-2		< 1.3E-3	< 3.7E-2	1.88E-03	8.36E-03
		Std. Dev.	49.5	1.25	8.48E-04	1.79E-02	0.00	5.36E-04	1.76E-03		4.15E-02	3.10E-03	0.22	0.00		0.00	0.00	1.85E-03	8.66E-03
		Num. of Obs.	13	4	13	4	4	13	13	NM	4	4	13	4	NM	4	4	13	13
7	PM_{10}	Maximum	118.5	0.65	2.06E-03	5.61E-03	< 1.7E-4	3.51E-02	5.99E-03		1.59E-02	3.68E-03	2.43	2.39E-02		1.51E-03	< 3.3E-2	6.06E-03	4.09E-02
		Minimum	0.6	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4		< 5.0E-4	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	20.9	0.08	5.30E-04	2.40E-03	< 1.7E-4	2.60E-03	1.04E-03		3.21E-03	3.34E-03	0.43	1.72E-02		1.18E-03	< 3.3E-2	2.07E-03	9.23E-03
		Std. Dev.	17.1	0.12	5.25E-04	1.08E-03	5.23E-12	4.94E-03	1.48E-03		2.92E-03	5.69E-05	0.65	1.76E-03		6.05E-05	6.69E-10	1.04E-03	9.39E-03
		Num. of Obs.	189	32	49	32	32	49	49	NM	32	37	49	32	NM	32	32	49	49
	TSP	Maximum	176.4	1.83	2.95E-03	2.08E-02	2.10E-04	4.13E-02	2.34E-02	10.92	3.80E-02	5.09E-03	4.77	3.56E-02	44.6	1.53E-03	3.39E-02	1.53E-02	6.74E-02
		Minimum	0.5	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4	< 1.3	< 5.0E-4	< 3.3E-3	< 0.2	1.67E-02	< 3.5	< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	26.3	0.15	4.24E-04	3.87E-03	1.69E-04	2.18E-03	1.11E-03	2.13	5.09E-03	3.42E-03	< 0.2	1.73E-02	12.2	1.18E-03	3.33E-02	3.13E-03	8.31E-03
		Std. Dev.	26.7	0.34	6.73E-04	4.13E-03	8.43E-06	5.52E-03	4.50E-03	1.96	7.56E-03	3.62E-04	1.00	3.20E-03	10.7	6.05E-05	1.03E-04	3.55E-03	1.42E-02
		Num. of Obs.	194	36	57	36	36	57	57	65	36	40	57	36	47	36	36	57	57
ALL SITES	PM_{10}	Maximum	150.7	2.01	4.61E-03	2.29E-02	2.71E-04	5.60E-02	1.19E-01		0.05	2.25E-02	19.11	0.12		5.07E-03	4.34E-02	0.13	0.42
		Minimum	0.2	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4		< 5.0E-4	< 3.3E-3	< 0.2	< 1.7E-2		< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	27.2	0.14	6.70E-04	3.90E-03	1.69E-04	3.36E-03	3.82E-03		5.84E-03	3.58E-03	1.10	1.86E-02		1.24E-03	3.34E-02	4.97E-03	2.15E-02
		Std. Dev.	14.3	0.16	6.51E-04	2.54E-03	4.21E-06	3.23E-03	6.12E-03		4.64E-03	6.02E-04	1.20	4.06E-03		1.56E-04	4.63E-04	6.23E-03	1.99E-02
		Num. of Obs.	1271	221	343	221	221	343	343	NM	221	259	343	221	NM	221	221	343	343
	TSP	Maximum	442.6	4.12	6.60E-03	4.51E-02	4.30E-04	6.91E-02	0.75	13.14	0.10	0.13	26.81	0.11	325.0	7.41E-03	5.41E-02	0.80	0.48
		Minimum	0.5	< 0.01	< 1.7E-4	< 1.7E-3	< 1.7E-4	< 1.3E-3	< 1.7E-4	< 1.3	< 5.0E-4	< 3.3E-3	< 0.2	< 1.7E-2	< 3.5	< 1.2E-3	< 3.3E-2	< 1.7E-3	< 8.3E-4
		Average	55.0	0.39	6.91E-04	7.64E-03	1.79E-04	4.04E-03	1.02E-02	1.83	1.18E-02	4.75E-03	0.98	1.81E-02	27.8	1.25E-03	3.35E-02	1.28E-02	3.11E-02
		Std. Dev.	34.0	0.51	8.00E-04	6.44E-03	2.74E-05	4.24E-03	2.80E-02	1.22	1.32E-02	5.14E-03	1.61	4.89E-03	26.5	3.13E-04	8.91E-04	2.88E-02	2.49E-02
		Num. of Obs.	1286	249	396	249	249	396	396	428	249	279	396	249	184	249	249	396	396
	Lo-vol	Maximum	202.0	18.36	8.24E-03	2.08E-01	9.38E-04	1.99E-02	4.01E-02		0.56	2.10E-02	4.98	< 1.9E-2		< 1.3E-3	< 3.7E-2	3.97E-02	1.94E-01
		Minimum	8.8	0.06	2.77E-04	< 1.9E-3	< 1.9E-4	< 1.5E-3	< 1.9E-4		3.15E-03	< 3.7E-3	< 0.2	< 1.9E-2		< 1.3E-3	< 3.7E-2	< 1.9E-3	4.54E-03
		Average	50.8	0.57	7.15E-04	1.18E-02	< 1.9E-4	2.57E-03	4.46E-03		2.18E-02	< 3.7E-3	0.58	< 1.9E-2		< 1.3E-3	< 3.7E-2	4.81E-03	1.95E-02
		Std. Dev.	59.3	3.3	1.36E-03	4.04E-02	1.59E-04	2.95E-03	5.46E-03		9.78E-02	4.94E-03	0.9	0.00		2.10E-04	2.93E-03	5.47E-03	2.80E-02
		Num. of Obs.	46	16	46	16	16	46	46	NM	16	16	46	16	NM	16	16	46	46

Note: TSP, Silica, and Lo-vol averages are the geometric mean.
Crystalline silica data, while entered in the TSP rows, are taken by NIOSH sampling methods not TSP as the table implies.
Fluorides shown represent TSP particulate fluorides from Site 3, 4, & 5, and combined TSP and gaseous fluorides from Sites 1, 2, 6, & 7.
NM - Not measured.
The period of record for particulate data is from October 1993 through October 1994.
All constituent concentration are in ug/m^3.

TABLE 4.3-2
Basic Statistics for Radionuclides from October 1993 through October 1994 [a]

Site	Type	Statistic	Particulate (µg/m³)	Pb-210	Po-210	Ra-226	Ra-228	Th-230	Th-232	Total U	U-234	U-235	U-238
1	PM_{10}	Maximum	79.5	1.17E-01	4.47E-02	5.31E-04	< 2.0E-3	8.02E-04	< 4.1E-5	2.24E-03	1.13E-03	5.16E-05	1.06E-03
		Minimum	4.1	< 5.7E-4	< 3.7E-4	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	< 3.4E-6	< 1.7E-6	< 7.4E-8	< 1.6E-6
		Average	30.2	2.40E-02	1.49E-02	5.31E-04	< 2.0E-3	1.02E-04	< 4.1E-5	1.92E-04	9.65E-05	4.41E-06	9.09E-05
		Std. Dev.	12.6	2.19E-02	1.09E-02	0.00	0.00	1.71E-04	0.00	3.42E-04	1.72E-04	7.86E-06	1.62E-04
		Num. of Obs.	193	48	48	49	29	48	28	49	49	49	49
2	PM_{10}	Maximum	150.7	7.46E-02	3.51E-01	8.48E-04	< 2.0E-3	1.50E-03	2.16E-04	5.29E-03	2.66E-03	1.22E-04	2.51E-03
		Minimum	6.6	< 5.7E-4	3.70E-04	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	< 3.4E-6	< 1.7E-6	< 7.4E-8	< 1.6E-6
		Average	56.5	2.39E-02	6.92E-02	5.37E-04	< 2.0E-3	2.85E-04	< 4.1E-5	8.03E-04	4.04E-04	1.85E-05	3.80E-04
		Std. Dev.	26.3	1.73E-02	8.32E-02	4.49E-05	0.00	2.98E-04	4.15E-05	8.40E-04	4.22E-04	1.93E-05	3.98E-04
		Num. of Obs.	193	50	48	50	30	43	23	50	50	50	50
3	PM_{10}	Maximum	67.4	8.37E-02	3.82E-02	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	2.28E-04	1.15E-04	5.24E-06	1.08E-04
		Minimum	1.5	< 5.7E-4	< 3.7E-4	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	< 3.4E-6	< 1.7E-6	< 7.4E-8	< 1.6E-6
		Average	21.3	2.45E-02	1.24E-02	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	2.38E-05	1.20E-05	5.48E-07	1.13E-05
		Std. Dev.	9.3	1.89E-02	9.26E-03	0.00	0.00	0.00	0.00	5.92E-05	2.98E-05	1.36E-06	2.80E-05
		Num. of Obs.	143	45	45	44	30	44	29	45	45	45	45
	Lo-vol	Maximum	202.0	3.50E-02	2.07E-02	2.88E-03	< 2.2E-3	3.49E-04	< 4.6E-5	3.95E-04	1.99E-04	9.08E-06	1.87E-04
		Minimum	29.2	1.18E-02	8.47E-03	< 5.9E-4	< 2.2E-3	< 3.9E-5	< 4.6E-5	< 3.7E-6	< 1.9E-6	< 8.2E-8	< 1.8E-6
		Average	66.5	1.80E-02	1.17E-02	6.91E-04	< 2.2E-3	8.63E-05	< 4.6E-5	1.74E-04	8.76E-05	4.01E-06	8.26E-05
		Std. Dev.	79.9	7.86E-03	3.87E-03	7.25E-04	0.00	1.33E-04	0.00	1.15E-04	5.81E-05	2.65E-06	5.47E-05
		Num. of Obs.	10	10	10	10	4	10	4	10	10	10	10
4	PM_{10}	Maximum	72.7	8.07E-02	3.64E-02	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	2.06E-04	1.04E-04	4.74E-06	9.78E-05
		Minimum	2.1	< 5.7E-4	< 3.7E-4	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	< 3.4E-6	< 1.7E-6	< 7.4E-8	< 1.6E-6
		Average	23.0	2.44E-02	8.74E-03	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	2.18E-05	1.10E-05	5.02E-07	1.03E-05
		Std. Dev.	11.1	1.81E-02	7.29E-03	0.00	0.00	0.00	4.62E-13	5.60E-05	2.82E-05	1.29E-06	2.65E-05
		Num. of Obs.	180	49	49	49	32	49	32	49	49	49	49
	Lo-vol	Maximum	106.6	2.96E-02	2.54E-02	< 5.9E-4	< 2.2E-3	2.52E-04	< 4.6E-5	6.45E-04	3.25E-04	1.48E-05	3.06E-04
		Minimum	29.8	1.20E-02	5.26E-03	< 5.9E-4	< 2.2E-3	< 3.9E-5	< 4.6E-5	< 3.7E-6	< 1.9E-6	< 8.2E-8	< 1.8E-6
		Average	52.0	1.91E-02	1.03E-02	< 5.9E-4	< 2.2E-3	4.55E-05	< 4.6E-5	1.86E-04	9.37E-05	4.29E-06	8.83E-05
		Std. Dev.	56.2	6.16E-03	6.31E-03	0.00	0.00	6.15E-05	0.00	1.81E-04	9.10E-05	4.16E-06	8.57E-05
		Num. of Obs.	12	12	12	12	4	12	4	12	12	12	12
5	PM_{10}	Maximum	90.8	6.25E-02	9.94E-02	< 5.3E-4	< 2.0E-3	9.24E-04	< 4.1E-5	4.74E-04	2.38E-04	1.09E-05	2.25E-04
		Minimum	0.2	< 5.7E-4	< 3.7E-4	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	< 3.4E-6	< 1.7E-6	< 7.4E-8	< 1.6E-6
		Average	18.5	2.21E-02	1.51E-02	< 5.3E-4	< 2.0E-3	7.21E-05	< 4.1E-5	5.24E-05	2.64E-05	1.20E-06	2.48E-05
		Std. Dev.	12.0	1.60E-02	1.89E-02	0.00	0.00	1.63E-04	4.29E-13	1.11E-04	5.58E-05	2.55E-06	5.26E-05
		Num. of Obs.	176	47	47	47	28	47	28	47	47	47	47
	Lo-vol	Maximum	92.5	3.89E-02	3.37E-02	< 5.9E-4	< 2.2E-3	< 3.9E-5	< 4.6E-5	6.67E-04	3.36E-04	1.53E-05	3.16E-04
		Minimum	27.4	1.34E-02	8.34E-03	< 5.9E-4	< 2.2E-3	< 3.9E-5	< 4.6E-5	2.02E-04	1.01E-04	4.64E-06	9.56E-05
		Average	48.1	2.07E-02	1.73E-02	< 5.9E-4	< 2.2E-3	< 3.9E-5	< 4.6E-5	3.43E-04	1.73E-04	7.90E-06	1.63E-04
		Std. Dev.	51.6	8.30E-03	8.80E-03	0.00	0.00	0.00	0.00	1.51E-04	7.59E-05	3.47E-06	7.15E-05
		Num. of Obs.	11	11	11	11	4	10	4	11	11	11	11
6	PM_{10}	Maximum	105.6	7.66E-02	3.93E-02	3.33E-03	7.51E-03	2.17E-04	< 4.1E-5	4.41E-04	2.22E-04	1.01E-05	2.09E-04
		Minimum	0.2	< 5.7E-4	< 3.7E-4	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	< 3.4E-6	< 1.7E-6	< 7.4E-8	< 1.6E-6
		Average	19.8	2.29E-02	6.66E-03	5.86E-04	2.15E-03	3.86E-05	< 4.1E-5	2.36E-05	1.19E-05	5.44E-07	1.12E-05
		Std. Dev.	11.6	1.74E-02	7.13E-03	3.92E-04	9.95E-04	2.55E-05	4.70E-13	8.42E-05	4.23E-05	1.94E-06	3.99E-05
		Num. of Obs.	197	50	51	51	31	51	31	51	51	51	51
	Lo-vol	Maximum	142.4	4.40E-02	1.39E-02	< 5.9E-4	< 2.2E-3	< 3.9E-5	< 4.6E-5	3.44E-04	1.73E-04	7.91E-06	1.63E-04
		Minimum	8.8	7.43E-03	3.63E-03	< 5.9E-4	< 2.2E-3	< 3.9E-5	< 4.6E-5	< 3.7E-6	< 1.9E-6	< 8.2E-8	< 1.8E-6
		Average	36.7	1.80E-02	6.78E-03	< 5.9E-4	< 2.2E-3	< 3.9E-5	< 4.6E-5	7.31E-06	3.68E-06	1.68E-07	3.47E-06
		Std. Dev.	49.5	9.67E-03	3.40E-03	0.00	0.00	0.00	0.00	1.12E-04	5.61E-05	2.56E-06	5.29E-05
		Num. of Obs.	13	13	13	13	4	13	4	13	13	13	13
7	PM_{10}	Maximum	118.5	6.26E-02	1.03E-01	< 5.3E-4	1.58E-02	2.50E-04	< 4.1E-5	4.54E-04	2.28E-04	1.04E-05	2.15E-04
		Minimum	0.6	< 5.7E-4	< 3.7E-4	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	< 3.4E-6	< 1.7E-6	< 7.4E-8	< 1.6E-6
		Average	20.9	2.14E-02	1.54E-02	< 5.3E-4	2.43E-03	3.99E-05	< 4.1E-5	4.27E-05	2.15E-05	9.82E-07	2.02E-05
		Std. Dev.	17.1	1.60E-02	1.84E-02	0.00	2.53E-03	3.24E-05	0.00	1.02E-04	5.13E-05	2.35E-06	4.84E-05
		Num. of Obs.	189	49	49	49	30	44	26	49	49	49	49
ALL SITES	PM_{10}	Maximum	150.7	1.17E-01	3.51E-01	3.33E-03	1.58E-02	1.50E-03	2.16E-04	5.29E-03	2.66E-03	1.22E-04	2.51E-03
		Minimum	0.2	< 5.7E-4	< 3.7E-4	< 5.3E-4	< 2.0E-3	< 3.5E-5	< 4.1E-5	< 3.4E-6	< 1.7E-6	< 7.4E-8	< 1.6E-6
		Average	27.2	2.33E-02	2.03E-02	5.40E-04	2.06E-03	8.68E-05	< 4.1E-5	1.66E-04	8.33E-05	3.81E-06	7.85E-05
		Std. Dev.	14.3	1.79E-02	2.21E-02	6.24E-05	5.03E-04	9.85E-05	5.93E-06	2.28E-04	1.15E-04	5.24E-06	1.08E-04
		Num. of Obs.	1271	338	337	339	210	326	197	340	340	340	340
	Lo-vol	Maximum	202.0	4.40E-02	3.37E-02	2.88E-03	< 2.2E-3	3.49E-04	< 4.6E-5	6.67E-04	3.36E-04	1.53E-05	3.16E-04
		Minimum	8.8	7.43E-03	3.63E-03	< 5.9E-4	< 2.2E-3	< 3.9E-5	< 4.6E-5	< 3.7E-6	< 1.9E-6	< 8.2E-8	< 1.8E-6
		Average	50.8	1.90E-02	1.15E-02	6.15E-04	< 2.2E-3	5.24E-05	< 4.6E-5	1.78E-04	8.94E-05	4.09E-06	8.43E-05
		Std. Dev.	59.3	8.00E-03	5.60E-03	1.81E-04	0.00	4.87E-05	0.00	1.40E-04	7.03E-05	3.21E-06	6.62E-05
		Num. of Obs.	46	46	46	46	16	45	16	46	46	46	46

Note: [a] Unless otherwise indicated all values are express in pCi/m³.

4.4 ATMOSPHERIC DISPERSION MODEL DESCRIPTIONS

The predictive atmospheric dispersion models used in this analysis are described briefly in this section. The theoretical basis of each model is described in the model's documentation and is not reproduced here. The basis for selection of these models was presented in the EMF RI/FS Work Plan (Bechtel, 1992a) and is also not reproduced here.

Simple Terrain Model

The ISCST2 atmospheric dispersion model was used to predict daily and average annual air constituent levels attributable to emissions from sources with potentially buoyant plumes for receptors located in simple terrain. This is the EPA-recommended model for RI/FS investigations due to its ability to simulate a large number of source types and utilize site-specific meteorological conditions (EPA, 1989b). This EPA-approved model has a steady-state, Gaussian dispersion feature which is used for simple terrain analysis from point sources.

Elevated Terrain Model

The Complex-I (version 90095) dispersion model was used to evaluate air constituent concentrations in elevated terrain attributable to emissions from point sources. This is the EPA-recommended model for screening rural elevated terrain impacts (EPA, 1986a). The Complex-I model is limited in that only point sources can be simulated by the model. This limits the model's effectiveness in elevated terrain for the varied type of sources (numerous line and area sources) found at the EMF facilities. However, as the most significant complex terrain impacts in the EMF area likely result from the elevated point source releases, Complex-I is an appropriate tool in evaluating these impacts.

Fugitive Dust Model (FDM)

The EPA's FDM air dispersion model computes concentration and deposition impacts from diverse types of fugitive dust sources using hourly averaged observations of meteorological data. FDM is an EPA non-guideline model recommended by EPA for use in evaluating fugitive dust impacts (EPA, 1990c). The sources may be point, line, volume, or area sources.

FDM was not designed to estimate impacts of buoyant point sources; thus, it does not have a plume rise algorithm and is not appropriate for modeling hot buoyant stack gases. FDM is based on well-known Gaussian Plume formulations for computing concentrations, and was specifically adapted by EPA to incorporate an improved gradient-transfer deposition algorithm. Additionally, FDM has an improved area source algorithm superior to the methodology found in ISCST2. Emissions for each source are apportioned by the user into a series of particle size classes. Gravitational settling and deposition velocities are calculated by FDM for each stability class. Concentration and deposition predictions are computed at user-selectable receptor locations.

4.5 MODEL MODIFICATIONS

The complex nature of this air pathways analysis, which includes diverse emission source types and constituents, simulation of impacts over varying terrain fields, and three atmospheric dispersion models, required certain modifications to the standard EPA versions of the models. Specifically, treatment of two common modeling challenges (intermediate terrain and combination of ISCST2, Complex-I, and FDM results) required revisions to the existing codes. Revisions to the codes affected only the combination of results from the three models and did not affect the results produced by each individual model. These changes are discussed in this section and Section 4.6.

4.5.1 INTERMEDIATE TERRAIN

To predict impacts at receptors located in intermediate terrain regions, modifications were made to both the ISCST2 and Complex-I to properly implement EPA's policy on modeling intermediate terrain receptors. These modifications were necessary because each individual model has no built-in ability to properly implement EPA's policy on modeling intermediate terrain receptors (EPA, 1990c).

Because modeling techniques differ for simple and complex terrain applications, the EPA has determined that model selection should be based on a source-by-source, receptor-by-receptor and hour-by-hour basis. Receptors located in simple terrain for a given source and meteorological condition were modeled with a simple terrain model, (i.e., ISCST2). Receptors located in complex terrain were modeled with the complex terrain model, (i.e., Complex-I) (reference Section 4.4). Receptors located in intermediate terrain were modeled with both simple and complex terrain models. As required by EPA policy, the higher of the two modeled concentration was used in subsequent analyses.

To date, there is no EPA-approved computer program which implements EPA's intermediate terrain policy. However, the Integrated Gaussian Model (IGM) has properly implemented EPA's

intermediate terrain policy (UEC, 1993). The specific nature and mix of source types found in this analysis, however, required use of ISCST2 capabilities (e. g., accounting for depositing particles) that were not available in the current version of IGM (UEC, 1992). Consequently, Bechtel developed an intermediate terrain model (called InterISC2) by meshing the ISCST2 and Complex-I model codes together and adding a maximum impact evaluator for intermediate terrain. InterISC2 (II2) is designed so that the model can run as either ISCST2 or Complex-I, or in a combined mode. II2 is based around ISCST2 and calls Complex-I as a subroutine. Model input/output is identical to that for ISCST2 with only one new variable added to the model input (i.e., the option that specifies the model mode of operation: ISCST2, Complex-I or InterISC2).

For a given source, receptor, and meteorological condition, II2 first determined if the receptor is simple, intermediate, or complex. If the receptor was simple, II2 used the ISCST2 model result. If the receptor was complex, II2 used the Complex-I model result. If the receptor was intermediate, II2 used the higher result obtained from the ISCST2 or Complex-I.

4.5.2 COMBINATION OF MODEL RESULTS

Due to the diversity of sources and models, it was determined that point sources would be modeled with II2, while area, line, and volume sources would be modeled with FDM. This division between model results presents technical challenges in determining overall modeled predictions for a specific constituent from both models. For example, PM_{10} emissions occur from all types of sources in both models. Without modification of the output processing portion of the modeling codes, the total PM_{10} impact resulting from both II2 and FDM could only be estimated by comparing the two model outputs.

To better estimate combined modeled predictions, slight modifications were made to the II2 and FDM codes so that the "partial contribution" files would be compatible with the POSTZ post-processor. These files are standard model optional output files that a user may request when all

intermediate model concentration estimates are required to be stored. One function of the POSTZ post-processor was to combine the II2 results with the FDM results.

FDM and II2 sources were modeled using a unit emission rate (e.g., 1 g/s for point sources and volume sources, 1 g/s-m^2 for area sources, and 1 g/s-m for line sources). In this approach, each model created a file for post-processing, which contained the concentration contributions from each source at each receptor for each hour modeled (e.g., the partial contribution files). The FDM and II2 partial contribution files were then combined using a modified version of the POSTZ
(version 1.0) post-processor.

After combining the files, an emissions scaling feature present in POSTZ obtained the constituent-specific concentrations for various averaging periods at each receptor. The POSTZ scaling feature multiplies the actual emission rate (input to POSTZ) from each source by its concentration contribution and totals these products to obtain the constituent-specific concentrations at each receptor. This approach reduces the computer run-time, since the FDM and II2 models need only be run once per year versus once per year per constituent. In addition, the POSTZ post-processor can be modified to output individual source contributions and to output results in formats not available in either FDM or II2.

4.6 DISPERSION MODEL BENCHMARK RUNS

A model, when modified, is typically compared against an EPA standard of the model to demonstrate that the modified model matches benchmark results obtained prior to the model's modification. An extensive presentation of such benchmark runs was made in an earlier report (Bechtel, 1993a). Communications with the EPA (EPA, 1994b) indicated that an additional demonstration of these benchmarks was not needed in this report.

4.7 MODEL INPUTS

Inputs to all models consist of sequential sets of meteorological observations, modeling option parameters, source data, and data defining the receptor grids. Constituent emission rates for input into the models were developed from the emission inventories presented in Section 3. Typical model inputs and outputs are presented in Appendix AH. These inputs and outputs are only a sample of the model runs made for this study.

Modifications from Original Work Plan

Model input used for atmospheric dispersion modeling are generally consistent with the input presented in the EMF Work Plan (Bechtel, 1992a). However, as the modeling analysis was being performed, it was determined that some deviations from the EMF Work Plan were required. These were:

- Receptor grid handling: a more limited receptor grid with more select spacing of receptors was necessary due to physical model limitations and time constraints. During the analysis for monitoring site location, it was found to be impractical to implement the grids described in the Work Plan. The proposed grids would have required extremely long model runs.
- Both the Chubbuck School and Idaho State University locations were evaluated due to their proximity to the facilities and the location of a State of Idaho PM_{10} State and Local Air Monitoring Station (SLAMS) monitoring site. Concentrations at these sites are described in Section 5. Since this output covers the general area and includes most of the nearby population zones, identification of additional discrete receptors was deemed unnecessary.

Building Downwash

Buildings interrupt the flow of air, creating turbulence. The phenomenon is referred to as building downwash. The area of turbulent air flow is referred to as the building wake region. Constituents emitted from vents or short stacks can be caught in this region, mixing rapidly downward, and resulting in ground-level impacts.

A building downwash analysis was performed using the EPA-approved Building Profile Input Program (BPIP) (version 95039). Appendix AG presents the results of the analysis, and indicates how various point sources were affected by plant buildings. For the building downwash analysis, building dimensions were visually approximated or taken from facility blueprints. A few of the buildings listed are actually open frameworks. The downwash analysis assumed that these frameworks are solid structures, therefore altering the air flow around the framework instead of the air flowing through the framework.

4.7.1 INTERISC2

Modeling Options

The II2 model, as used in this analysis, implements the standard EPA-defined regulatory default values for ISCST2 and Complex-I. These defaults consist of the following II2 options (which correspond to the ISCST2 model options) specified for regulatory usage of the model:

(1) Final plume rise

(2) Stack-tip downwash

(3) Buoyancy-induced dispersion

(4) Use calms processing routine

(5) Missing data processing routine not used

(6) Default wind profile exponents

(7) Default vertical potential temperature gradients

(8) "Upper bound" values for supersquat buildings

(9) No exponential decay for rural mode

(10) Directional dependent downwash

The II2 model also contains the Complex-I model using the following EPA options:

(1) Use terrain adjustment IOPT(1) = 1

(2) Use buoyancy-induced dispersion IOPT(4) = 1

(3) Set IOPT(25) = 1

(4) Use the following terrain adjustment values: 0.5, 0.5, 0.5, 0.5, 0.0, 0.0

(5) Set ZMIN = 10.0

Source Inputs

The source input parameters for the FMC, Simplot, and BAPCO facilities are provided in Section 3 as Tables 3-29, 3-30, and 3-31, respectively. The building downwash output was also placed into the model input file.

Receptor Grid

Figure 4.7.1-1 presents the II2 grid as implemented for this analysis. The grid shows regularly spaced receptors over the model domain. The receptors identified as ISC receptors are for the II2 model. A dense grid of receptors within 100 meters of monitoring Sites 1, 2, and 7 were added subsequent to the modeling analysis reported in the *Characterization of Ambient Air Quality in the EMF Study Area* report (Bechtel, 1994k). This dense grid is an aid in evaluating model performance at receptors close to emission sources. The receptors representing monitoring Sites 3, 4, 5, and 6 are of sufficient distance that the normal model process of diffusion and plume spreading easily compensates for source location uncertainties.

4.7.2 FDM

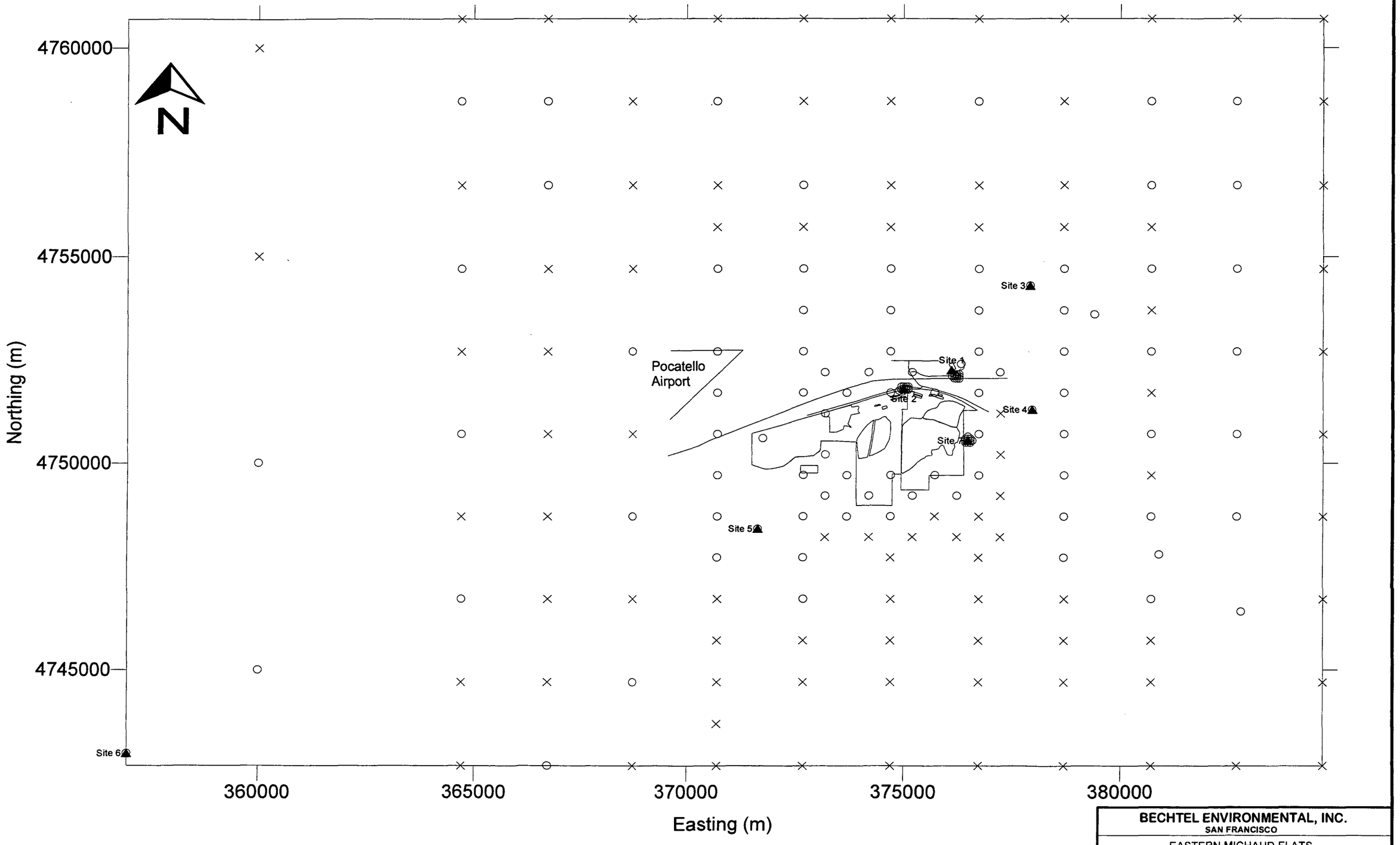
Modeling Options

FDM is an EPA non-guideline model and does not have specific regulatory-required modeling options (EPA, 1992d). The modeling options used in this study were:

- Default 5-line integration area source algorithm;
- Preprocessed meteorological file;
- Model computation of the deposition velocity and gravitational settling velocity on an hour by hour basis;
- Calms recognition is active;
- Surface roughness height is 25 cm;
- The global value for density of the particulate matter is 2.5 grams per cubic meter, unless the aerodynamic particle size was used; in that case 1.0 gram per cubic meter was utilized;
- The anemometer height above ground is 19.0 meters (62 feet);
- The PM_{10} characteristic particle diameter classes are 2.5μm, 5μm, and 10μm, with size distribution determined on a source-specific basis;
- The TSP characteristic particle diameter classes are 2.5μm, 5μm, 10μm, and 30μm with size distribution determined on a source-specific basis.

Source Inputs

The source input parameters for the point sources at the FMC, Simplot, and BAPCO facilities are provided in Section 3 as Tables 3.4.1-1 through 3.4.1-6, respectively. Due to physical model limitations (i.e., the model can only accept 200 sources at one time; computer run time increases dramatically with the number of sources) many FDM sources were combined. The source combinations were described in Section 3.4.



O - FDM and ISC receptors
X - ISC receptors only

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EMF Model Grid of Receptors

JOB No.	DRAWING No.	REV
21372	FIGURE 4.7.1-1	O

Receptor Grid

Figure 4.7.1-1 shows the receptor grid for FDM. A modification of the II2 grid was used in FDM. Regularly spaced receptors were kept over the City of Pocatello. Since the constituent concentrations tend to decrease with distance, and prevailing winds are from the southwest, some receptors were eliminated to the north and west to reduce computer run time. Discrete receptors were placed at the current State of Idaho and facility monitoring locations.

Because FDM does not simulate complex terrain dispersion and predictions are not valid over elevated terrain, receptors were not placed over the Bannock Range south of the facilities.

5.1 MODEL PERFORMANCE EVALUATION PROCEDURES AND CRITERIA

EPA Region 10 personnel recommended the use of methods presented in Cox (1988) to evaluate the accuracy and representativeness of model predictions (Ryan, 1992). As outlined in this reference, the standard criterion utilized to evaluate atmospheric dispersion model performance is that model-predicted concentrations (or activities) should be within a factor of 2 of observed data. Region 10 staff requested that the model performance analysis include comparisons of both predicted average annual and daily constituent levels with average annual and 24-hour duration monitoring results. These comparisons are presented in Sections 5.2 and 5.3, respectively.

Numerous studies have shown that general purpose gaussian atmospheric dispersion models show skill at predicting airborne impacts over various time periods, when sufficient meteorological variation is applied to the model. EPA modeling guidance recommends that the meteorological data set used in a modeling study contain at least one year of hourly onsite measurements or five years of hourly offsite measurements (EPA, 1986a). The meteorological data set used in the EMF modeling study meets this recommendation.

Studies of models have demonstrated that models show little skill in predicting the exact location and time of occurrence of maximum constituent concentrations (or activities), when compared with monitoring data. However, studies have also shown that the magnitude of the maximum concentration (or activity) tends to be accurately predicted by these same models. Because of this, EPA protocol (Cox, 1988) recommends that model predictions be evaluated both in a paired and unpaired (in time and space) fashion. Predicted concentrations are generally within a factor of 2 when compared with observed concentrations in a manner unpaired in time and space.

In keeping with this guidance, model performance was evaluated in the following manner:

Comparisons of Average Annual Concentrations (or Activities) (Reported in Section 5.2)

- The highest model-predicted average annual constituent concentrations (or activities) were compared with the highest average annual monitored constituent levels, independent of the location of the highest average annual value (i.e., paired in time but not in space);
- The average annual constituent levels predicted at each of the 7 monitoring stations were compared with the average annual monitored constituent levels at each station (i.e., paired in time and space);

Comparisons of Daily Concentrations (or Activities) (Reported in Section 5.3)

- All daily constituent levels predicted at each monitoring station were compared with all daily constituent levels observed at the station (i.e., unpaired in time, but paired in space);
- The mean daily constituent level predicted at each monitoring station for the group of days on which monitoring occurred was compared with the mean daily constituent levels monitored at each station (i.e., paired in time and space);
- Predicted daily constituent levels at each monitoring station were compared with the daily monitored constituent levels at each station for those days when Site 6 (the background monitoring site) was predominantly upwind of the EMF facilities (i.e., paired in time and space);

Comparisons on Case Study Days (Reported in Appendix AJ)

- The emission inventories were adjusted, as appropriate, to reflect specific plant operations on five days (October 24, 1993; January 4, 1994; January 20, 1994; April 14, 1994; and June 6, 1994). Predicted daily constituent levels at each monitoring station were compared with observed levels, as well as with predictions made using the unadjusted inventories (i.e., paired in time and space). This was done to evaluate whether the emission inventories and modeling methods were representative of the variability of plant operating conditions.

Model results were judged to be satisfactory if the upper range of the predicted data (plus background) was within a factor of 2 of observed data. Background constituent concentrations (or activities) were established using the analytical results from monitoring samples collected at

Site 6, when this site was upwind of the EMF facilities. Background levels were added to the model predictions because background sources were not included in the EMF facility emission inventories, and thus are not accounted for in the model predictions. Section 4.3 of Volume 1 of Part III of the RI Report provides a detailed discussion of how these background conditions and samples were identified.

In comparing an average annual model prediction with an average annual monitoring result, the arithmetic average constituent concentration (or activity) in background was added to the model predictions. If a constituent was never detected in the background samples, no addition was made to the model-predicted level.

In comparisons of predicted daily levels with observed daily levels, the background constituent concentration (or activity) added to the predicted value was the level present in the sample at Site 6 on that day. If a constituent was not detected in the background sample on that day, no addition was made to the model-predicted level.

For reference purposes, the seven EMF ambient air quality monitoring site locations can be subdivided into three general classes:

(1) Sites 1, 2, and 7 are near-field monitoring sites, positioned on or near the perimeter of the industrial operations area. These sites were selected as monitoring stations because previous atmospheric dispersion modeling (Bechtel, 1993a) identified them as points of potential maximum concentration of various constituents emitted by the facilities. It should be noted that Site 2, while meeting the needs of CERCLA sampling does not satisfy NAAQS monitoring station study guidelines, due to the presence of a road and overwhelming influence of FMC's shale pile.

(2) Sites 3, 4, and 5 represent far-field monitoring sites. Monitoring at these locations was requested by the EPA and IDEQ to evaluate ambient constituent concentrations and activities in the vicinity of residential areas.

(3) Site 6 was chosen as the background site because previous studies (Bechtel, 1993a) showed that the site should be well beyond any direct influence from the facilities. The site is over 12 miles southwest of the facilities and is upwind from the facilities most of the time.

The impact of emissions from many other potential emission sources within the study area was monitored at these sites, whereas only emissions from the FMC, Simplot and BAPCO facilities were modeled.

Several other air monitoring data sets exist for the area but were not used in this model performance analysis. These data sets are the IDEQ's SLAMS data for PM_{10}, and portable sampler PM_{10} data taken during a one year saturation study by the IDEQ (EPA, 1992c). These other data sets were not utilized because the EMF ambient air quality data were collected for use in determining atmospheric dispersion model performance, were subject to rigorous data quality objectives, and included a broader set of constituents. Additionally, portable sampler PM_{10} data taken from the IDEQ's saturation study were not used because the method utilized was not an EPA reference method for PM_{10} and QA/QC data from this data set were not available.

5.2 RESULTS

The predicted average annual concentrations (or activities) for particulates, total fluorides, metals, total silica, and radionuclides are presented in this section. Section 5.2.1 describes the location of the highest predicted average annual level for each constituent and compares the predicted levels with EPA screening levels and other guidelines. This section also compares the predicted levels with the highest average annual monitored levels.

Section 5.2.2 presents a detailed review of modeling results for each constituent. It includes graphical displays (isopleth maps) of the average annual predicted concentration (or activity) across the array of 212 modeled receptors. It also compares model-predicted and monitored levels at each of the seven air monitoring stations.

5.2.1 HIGHEST PREDICTED AVERAGE ANNUAL CONCENTRATIONS AND ACTIVITIES

Table 5.2.1-1 presents the highest average annual concentrations (or activities) computed for the modeled period (October 1, 1993 through September 30, 1994) from the average annual emission inventories for FMC, Simplot, and BAPCO. The geographic coordinates for each maximum predicted constituent level, listed in Table 5.2.1-1, are shown on Figure 5.2.1-1. The predicted values are for the PM_{10} fraction except for TSP and total fluoride, which was modeled for the TSP fraction. The highest-modeled average annual concentrations (or activities) occurred at one of four grid receptor locations.

Three of the grid receptor locations were within an unoccupied and undeveloped right-of-way between the northern fenceline of the industrial operations areas and Highway 30. Within this area, the model-predicted concentrations (or activities) of beryllium, total fluoride, lead, radium-226, and uranium-235 were less than their EPA screening levels, whereas arsenic, nickel, total phosphorus, polonium-210, thorium-230, and uranium-234 and -238 were greater than their screening levels. These comparisons are also summarized in Table 5.2.1-1.

TABLE 5.2.1-1
EMF Air Pathways Modeling Results

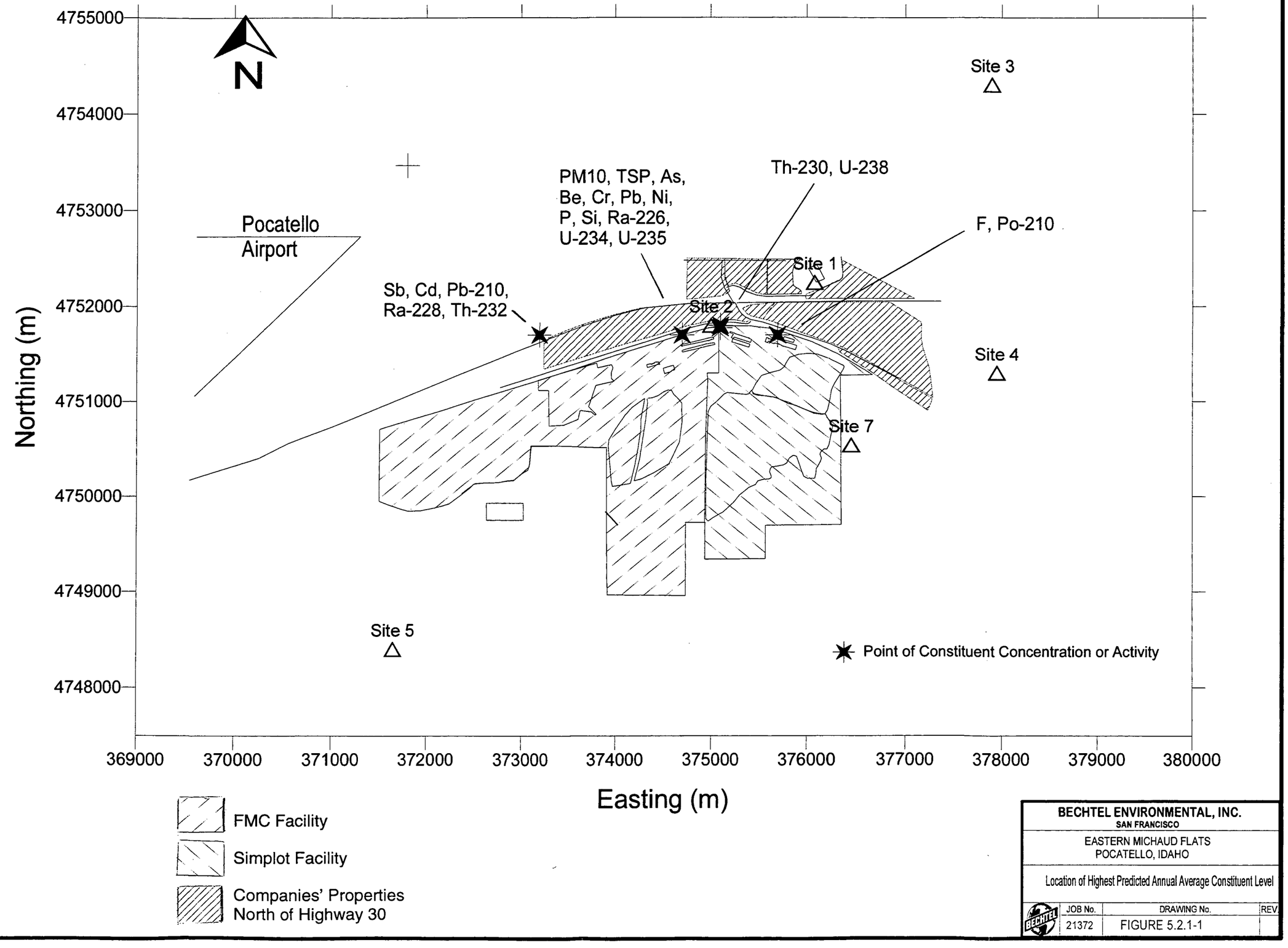
Constituent	Highest Annual Average Concentration ($\mu g/m^3$)	Location		EPA Region 10 Screening Level ($\mu g/m^3$)[1]
		X-coordinate	Y-coordinate	
PM_{10}	40.08	374700	4751700	Not provided
TSP	74.13	374700	4751700	Not provided
Antimony	4.79E-03	373200	4751200	1.5
Arsenic	1.82E-03	374700	4751700	5.7E-04
Beryllium	1.06E-05	374700	4751700	1.0E-03
Cadmium	7.75E-03	373200	4751200	1.4E-03
Total Chromium	5.75E-02	374700	4751700	NA
Total Fluoride	3.34	375700	4751750	8.3
Lead	2.31E-03	374700	4751700	1.5
Nickel	1.08E-02	374700	4751700	1.0E-02
Total Phosphorus	3.04	374700	4751700	0.3
Total Silica	4.5	374700	4751700	NP
Constituent	**Highest Annual Average Activity (pCi/m^3)**	**Location**		**EPA Region 10 Screening Level (pCi/m^3)[1]**
		X-coordinate	**Y-coordinate**	
Lead-210	1.23E-03	373200	4751200	1.2E-03
Polonium-210	1.05E-01	375700	4751750	1.8E-03
Radium-226	4.63E-04	374700	4751700	1.6E-03
Radium-228	4.73E-05	373200	4751200	6.9E-03
Thorium-230	6.54E-04	Site 2+		2.0E-04
Thorium-232	4.73E-05	373200	4751200	2.0E-04
Uranium-234	3.78E-04	374700	4751700	2.0E-04
Uranium-235	1.60E-05	374700	4751700	2.0E-04
Uranium-238	4.70E-04	Site 2+		1.0E-04

Footnotes:

[1] As presented in a July 2, 1993 letter from W. Adams (EPA Region 10).

NA = Not applicable.

NP = Not provided.



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Location of Highest Predicted Annual Average Constituent Level

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21372	FIGURE 5.2.1-1	

The fourth grid receptor location is within an unoccupied and undeveloped right-of-way along Interstate 86. At this location, the model-predicted concentrations (or activities) of antimony, radium-228, and thorium-232 were less than their EPA screening levels, while the activity of cadmium and lead-210 exceeded their screening levels (Table 5.2.1-1).

The EPA screening levels (except for total fluorides and total phosphorus) are believed to have been calculated by EPA as the concentration (or activity) that corresponds with a 1E-6 risk level for an assumed long-term residential exposure condition. The derivation of the total fluoride and total phosphorus screening levels are unknown. EPA did not establish a screening level for total silica.

Neither the buffer area between the industrial operations area and Highway 30, nor the right-of-way along Interstate 86 are residential in character, and both areas are expected to remain undeveloped for residential purposes. Consequently, comparisons with EPA's screening levels overstates the potential risk associated with exposure to the predicted constituent levels. Thus, it would be more appropriate to compare the model predictions with risk criteria that might be relevant to land use practices that occur in the near vicinity of the predicted maxima, such as a commercial or industrial use of the land.

One potential set of guidelines relevant to assessing monitored and modeled constituent levels are the Threshold Limit Values (TLVs) published by the American Conference of Governmental Industrial Hygienists (ACGIH, 1993). None of the monitored or model-predicted constituent levels exceed its TLV. For example, the TLV for arsenic (10 $\mu g/m^3$) is approximately four orders of magnitude greater than the highest average annual monitored or modeled arsenic concentration. The TLV for cadmium (PM_{10} fraction, 2.0 $\mu g/m^3$) is approximately two orders of magnitude greater than the highest average annual monitored or modeled cadmium concentration. Similarly, the total fluoride and total phosphorus TLVs (2500 $\mu g/m^3$ and 100 $\mu g/m^3$, respectively) are approximately three and two orders of magnitude greater, respectively, than the highest-predicted average annual monitored or modeled concentrations of each constituent. The TLV for uranium (200 $\mu g/m^3$) is approximately 5 orders of magnitude greater than the highest average annual

concentration of total uranium monitored (1.2E-03 $\mu g/m^3$). Thus, based on these standard industrial workplace criteria, constituent levels along the fenceline area, which was found to be the area of both the greatest monitored and modeled constituent levels, are between 100 to 1000 times below levels of concern in an industrial or commercial setting.

Predicted Levels at Each Point of Highest Concentration

Of the 21 constituents modeled, the highest average annual concentrations (or activities) for 12 were predicted at the grid receptor with coordinates 374700 (Easting) and 4751700 (Northing) as shown on Table 5.2.1-1. This point is north of the FMC ore pile and within the south side of the Highway 30 right-of-way. The highest average annual levels for PM_{10}, TSP, arsenic, beryllium, chromium (total), lead, nickel, phosphorus (total), silica (total), radium-226, and uranium-234 and -235 were predicted to occur at this grid receptor. Of these constituents, the predicted level for beryllium (1.06E-05 $\mu g/m^3$) was less than the typical instrument detection level (IDL) for beryllium (1.7E-04 $\mu g/m^3$) (reference Section 3.3 of Volume I, Part III of the RI Report for a discussion of IDLs). Similarly, the predicted activity of radium-226 (4.63E-04 pCi/m^3) was less than its IDL (5.3E-04 pCi/m^3).

At this model grid receptor, the predicted average annual concentrations (or activities) of beryllium, lead, radium-226, and uranium-235 were less than the EPA screening level for these constituents, whereas the highest predicted average annual concentrations (or activities) of arsenic, nickel, total phosphorus, and uranium-234 were greater than their EPA screening levels. The EPA screening level for total chromium assumes that all of the chromium was present in a hexavalent form. As discussed in Section 3, less than 1% of the total chromium emitted from EMF sources is present in a hexavalent form, thus a comparison with the EPA screening level is inappropriate. No screening level was provided for total silica.

The highest average annual concentrations (or activities) for total fluoride and polonium-210 were predicted at the grid receptor with coordinates 375700 (Easting) and 4751750 (Northing). This point is north of the Simplot main plant area and within the south side of the Highway 30 right-of-

way. The polonium-210 activity exceeded the screening level provided by EPA, whereas the total fluoride concentration did not exceed its screening level.

The highest average annual concentrations (or activities) for antimony, cadmium, lead-210, radium-228, and thorium-232 were predicted at the grid receptor with coordinates 373200 (Easting) and 4751200 (Northing). This point is north of the BAPCO facility along the north side of the right-of-way of Interstate 86. The predicted activity of radium-228 (4.73E-05 pCi/m^3) was less than its IDL (6.9E-03 pCi/m^3). The predicted concentration (or activity) of antimony, radium-228, and thorium-232 were also less than their EPA screening levels. The predicted activity of lead-210 (1.23E-03 pCi/m^3) was just above the EPA screening level (1.20E-03 pCi/m^3), but below the average annual background activity of lead-210 detected at Site 6 (1.7E-02 pCi/m3). The predicted concentration of cadmium (7.75E-03 $\mu g/m^3$) exceeded the screening level (1.40E-03 $\mu g/m^3$).

The highest concentrations (or activities) of thorium-230, and uranium-238 were predicted at a grid receptor located in the vicinity of air monitoring Site 2. (To enhance model resolution, a grid of 30 receptors were placed at 50-meter intervals around each of the near-field monitoring Sites 1, 2, and 7). Site 2 is just north of the FMC ore pile within the south side of the right-of-way of Highway 30. The predicted thorium-230 activity (6.54E-04 pCi/m^3), and uranium-238 activity (4.70E-04 pCi/m^3) exceeded the EPA screening levels (2.00E-04 pCi/m^3 and 1.0E-04 pCi/m^3, respectively.)

Comparisons of Model Predictions with Monitoring Results

In Table 5.2.1-2, the highest model-predicted concentrations (and activities) are compared with the highest-averaged monitored concentrations (or activities). The highest-averaged monitored concentration is the highest value from the set of averaged constituent concentrations (or activities) detected at each monitoring site. The highest-averaged monitored concentrations (or activities) of all constituents occurred at Site 2, except lead-210 (Site 3), radium-226 (Site 6), and radium-228 (Site 7).

Table 5.2.1-2
Comparison of Model Predictions with Monitoring Results

Constituent	Highest-Annual Average Modeled Concentration‡ ($\mu g/m^3$)	Highest-Averaged Monitored Concentration* ($\mu g/m^3$)	Highest-Annual Average Modeled Concentration with Background ($\mu g/m^3$)	Model (with background) to Monitoring Comparison
PM_{10} †	40.1	56.5	55.1	within 2
TSP	74.1	137.1	116.1	within 2
Antimony ‡	4.79E-03	NA	NA	NA
Arsenic ‡	1.82E-03	1.27E-03	2.33E-03	within 2
Beryllium ‡	1.06E-05	1.79E-04	1.06E-05	agrees†
Cadmium ‡	7.75E-03	1.16E-02	7.75E-03	within 2
Total Chromium ‡	5.75E-02	1.74E-02	5.77E-02	> 2
Total Fluoride ‡	3.3	3.7	4.9	within 2
Lead †	2.31E-03	NA	NA	NA
Nickel ‡	1.08E-02	4.85E-03	1.09E-02	> 2
Total Phosphorus ‡	3.0	5.5	3.0	within 2
Total Silica ‡	4.5	NA	NA	NA
Constituent	**Highest-Annual Average Modeled Activity (pCi/m^3)**	**Highest-Averaged Monitored Activity (pCi/m^3)**	**Highest-Annual Average Monitored Activity with Background (pCi/m^3)**	**Model (with background) to Monitoring Comparison**
Lead-210	1.23E-03	2.45E-02	1.82E-02	within 2
Polonium-210	1.05E-01	6.92E-02	1.09E-01	within 2
Radium-226	4.63E-04	**	4.63E-04	within 2†
Radium-228	4.73E-05	**	4.73E-05	within 2†
Thorium-230	6.54E-04	2.85E-04	6.54E-04	> 2
Thorium-232	4.73E-05	**	4.73E-05	agrees†
Uranium-234	3.78E-04	4.04E-04	4.03E-04	within 2
Uranium-235	1.61E-05	1.85E-05	1.69E-05	within 2
Uranium-238	4.70E-04	3.80E-04	4.88E-04	within 2

Footnotes:

NA - Not analyzed.

Within 2 = Model predictions are within a factor of 2 of the highest-averaged monitored level.

> 2 = Highest average annual modeled level is greater than twice the highest average annual monitored level.

< 2 = Highest average annual modeled level is less than one-half the highest average annual monitored level.

* Highest-averaged monitored values are those that were observed among the averaging of data from monitoring Sites 1 through 7. Averaging times for monitored data are functionally equivalent to annual averages although the PM_{10} and TSP are averaged over 13 months of data and the remainder of the constituents are averaged over only 6 months.

** Two or less detected values.

† Model prediction was compared with the IDL. Both model and monitoring agree that constituents are below detection levels.

‡ Highest-modeled values are those that occurred anywhere over the modeled area. The location of the modeled points may be found on Table 5.2.1-1.

The highest predicted average annual levels in Table 5.2.1-2 are shown both with no addition for background and with background included. If the constituent was not detected in the background samples (e.g., beryllium), no adjustment was made to the model-predicted level. Background was included for each detected constituent by adding the arithmetic average of the constituent's level in samples collected at Site 6 when it was upwind of the EMF facilities. The arithmetic average of the background constituent results was used, rather than other statistics because the model predicted an arithmetic average annual concentration (or activity).

Comparisons That Exclude Background

With no addition of background contributions, the highest predicted average annual concentrations (or activities) of PM_{10}, TSP, arsenic, cadmium, total fluoride, total phosphorus, polonium-210, and uranium-234, -235, and -238 were within a factor of two of their highest average monitored levels. Without the inclusion of background, the highest predicted average annual activity of lead-210 (1.23E-03 pCi/m^3) was less than a factor of two of its highest average monitored level. The highest predicted activity of lead-210 was also less than the background activity detected at Site 6 (1.7E-02 pCi/m^3).

The highest predicted average annual level (without inclusion of background) of total chromium, nickel, and thorium-230 were more than a factor of two greater than their highest average monitored levels. The predicted activity of beryllium was below its IDL. Beryllium was not detected at any monitoring site except Site 2, where it was detected in only several samples at concentrations just above the IDL. Thus, a numerical comparison of model-predicted and monitored beryllium concentrations is inappropriate. Rather, it can be concluded that the model and monitoring data agree that beryllium was not present at detectable concentrations.

Comparisons of modeling and monitoring results cannot be made for antimony, lead, and total silica. The first two were not analyzed in the monitoring program, although a component of total silica — crystalline silica — was analyzed in the monitoring program in the TSP size-fraction.

The model-predicted concentrations of antimony (4.79E-03 $\mu g/m^3$) and lead (2.31E-03 $\mu g/m^3$) were both approximately three orders of magnitude below their EPA screening levels (1.5 $\mu g/m^3$ and 1.5 $\mu g/m^3$, respectively). EPA did not provide a screening level for total silica. However, both the model-predicted concentration of total silica (4.5 $\mu g/m^3$) and the highest average monitored concentration of crystalline silica (52.1 $\mu g/m^3$), which was composed overwhelmingly of quartz, were below a TLV guideline (100 $\mu g/m^3$).

Neither radium-226 and -228 were detected more than twice during the monitoring program (out of nearly 500 samples), and when detected, the sampling stations were upwind from the EMF facilities (reference Section 4.2.2 of Volume 1 of Part III for further discussion). As previously described, the predicted activities of both radium-226 and -228 were below their IDL. Thus, in combination, monitoring and modeling results demonstrate that the contribution of these radionuclides from the EMF facilities, if any, in ambient air was below detectable levels. The predicted activities of radium-226, and -228 were also less than their EPA screening levels.

Thorium-232 was never detected in samples collected during the monitoring program. The predicted activity of thorium-232 (4.73E-05 pCi/m^3) was within a factor of two of its IDL (4.1E-05 pCi/m^3). The predicted activity of thorium-232 was less than the EPA screening level.

Comparisons That Include Background

With the addition of background to the highest predicted average annual concentrations (or activities), predicted levels were within a factor of two of observed levels for all constituents except total chromium, nickel, and thorium-230 (Table 5.2.1-2). In these cases, the predicted levels were greater than the highest average monitored level by more than a factor of two. The model overpredicted total chromium by a factor of 3.3, nickel by a factor of 2.2, and thorium-230 by a factor of 2.3.

A review of model results indicates that the leading source of total chromium and nickel that influenced the highest-predicted concentrations were fugitive emissions from ore handling at FMC. Results also indicate that the leading source that influenced the highest predicted activity

of thorium-230 was the emission of fugitives from the granulation # 1 unit at Simplot. It is possible that samples used to characterize these sources overstate the typical concentration of total chromium and nickel or the activity of thorium-230 contained in the fugitive dusts emitted from these sources.

Model Performance

These comparisons indicate that the model adequately characterizes the highest average annual impacts associated with average annual emissions from the EMF facilities during the October 1993 through September 1994 period of study. Comparisons of the highest-predicted average annual concentrations or activities (including background) with the highest average monitoring results are within the EPA model performance guideline of a factor of two for 15 of the 18 constituents for which comparisons can be made.

Of the remaining 3 constituents, the model overpredicted the highest average annual concentration (or activity). These cases (total chromium, nickel, and thorium-230) may be attributable to over-estimation of constituent emissions.

The highest average annual concentrations (or activities) are predicted to occur within undeveloped and unpopulated areas of land, either just north of the fenceline separating the industrial operations areas of the EMF facilities from Highway 30, or along the right-of-way of Interstate 86. These levels are between 100 and 1000 times below concentrations (or activities) that would be of concern in an industrial or commercial workplace.

5.2.2 Average Annual Concentrations and Activities within the Study Area

This section describes the predicted average annual constituent concentrations and activities across the geographic extent of the modeled domain of the 212 grid receptors. It also compares the levels predicted at the seven air monitoring stations with the average annual concentrations (or activities) observed in the samples collected at these sites between October 1, 1993 through September 30, 1994.

The average annual modeled concentrations and activities for each constituent were plotted as lines of equal concentrations (or activities) — referred to as isopleths — and are shown in Figures 5.2.2-1 through 5.2.2-21. The plotted values have not been adjusted to include background contributions. Each figure also displays the EPA screening level, the annual average background value, and the highest-modeled annual average concentration or activity. The typical instrument detection levels (or IDL) are listed for those constituents included in the EMF ambient air monitoring program, and the IDL is included as a bolded isopleth to illustrate any model-predicted concentrations (or activities) that are above the instrument detection levels.

The FMC and Simplot property boundaries are identified on Figures 5.2.2-1 through 5.2.2-21 with two types of cross-hatched shading patterns. Land within these boundaries is either used for industrial or commercial purposes, or is vacant or undeveloped. A dense cross-hatching was used to identify the company-owned property north of Highway 30, while a less-dense pattern was used to identify company-owned property south of the highway. The denser pattern was used to avoid the possibility that an isopleth line plotted within this area might be mistaken for a line used to characterize property ownership. Use of a dense pattern south of the highway to clarify the display of isopleth lines was not necessary.

In the text describing the location of the highest predicted concentration (or activity), reference is made to site features, such as the FMC ore pile or "north of the Simplot facility". The reference is intended only as a convenience in orienting the reader to the isopleth map. It does not imply that the site feature mentioned is the source of the constituent. The text also compares model results with monitored levels.

Tables 5.2.2-1 through 5.2.2-17 summarize the model-predicted average annual concentrations (or activities) for each constituent and compare these results with observed data. Each table lists (under Column A) the model predictions at each of the 7 air monitoring site locations. Also listed are the average annual constituent concentrations (or activities) at each site for samples collected during the monitoring program (shown under Column B). The arithmetic average concentration (or activity) for samples collected at the background monitoring site (Site 6) when this site was predominantly upwind from the EMF facilities was added to the average annual

predicted concentrations. No background addition was made for background for constituents that were not detected in these background samples (e.g., beryllium). These background-adjusted results (shown under Column C) were compared with the average annual monitoring results for each site as a measure of model performance. These comparisons are summarized under Column D in each table; comparisons within a factor of two are an indication of satisfactory model performance, per EPA guidelines.

5.2.2.1 Particulates

PM_{10} model isopleths are shown in Figure 5.2.2-1. The predicted maximum ground level impact occurred just north of FMC's ore stockpiles with decreasing concentrations extending outward from the facilities. The predicted highest average annual concentration (without background) was 40.1 $\mu g/m^3$. This was less than the highest average monitored concentration of 56.5 $\mu g/m^3$ (encountered at Site 2). However, with the addition of the arithmetic average background concentration of PM_{10} (15 $\mu g/m^3$), the predicted highest average annual PM_{10} concentration (55.1 $\mu g/m^3$) is comparable with the highest average monitored concentration.

Table 5.2.2-1 summarizes model predictions of PM_{10} at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background concentrations, were within a factor of two of monitored levels) at all monitoring sites. This indicates that the average annual PM_{10} emission inventories and dispersion model successfully predicted average annual PM_{10} concentrations within the study area during the 1993-1994 study period. It also demonstrates that the selection of Site 6 as the background site satisfies EPA model performance guidance, in that the model-predicted PM_{10} concentration was less than 1 $\mu g/m^3$.

TABLE 5.2.2-1
AVERAGE ANNUAL PM_{10} PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		A Average Annual Predicted Concentration ($\mu g/m^3$)	B Average Annual Monitored Concentration ($\mu g/m^3$)	C Average Annual Predicted Concentration (with background[1]) ($\mu g/m^3$)	D Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	6.1	30.2	21.1	Within 2
	2	31.5	56.5	46.5	Within 2
	7	8.2	20.9	23.2	Within 2
Far-field Sites	3	1.4	21.3	16.4	Within 2
	4	2.1	23.0	17.1	Within 2
	5	1.4	18.5	16.4	Within 2
Background	6	0.1	19.8	NA	Site meets EPA's standard for background site (<1 $\mu g/m^3$)

Arithmetic average background concentration = 15 $\mu g/m^3$.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

TSP model isopleths are shown in Figure 5.2.2-2. The predicted maximum ground level impact occurred just north of FMC's ore stockpiles, with rapidly decreasing concentrations extending outward from the facilities. The predicted highest average annual concentration (without background) was 74.1 $\mu g/m^3$; this was less than the highest average monitored concentration of 137.1 $\mu g/m^3$ (Site 2). With the addition of the arithmetic average background concentration of TSP (42 $\mu g/m^3$), the predicted highest average annual TSP concentration (116.1 $\mu g/m^3$) is within a factor of two of the highest average monitored TSP concentration.

Table 5.2.2-2 summarizes model predictions for TSP at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background concentrations, were within a factor of two of monitored levels) at all sites except Site 7, at which the model slightly overpredicted TSP by a

factor of 2.1. This indicates that the average annual TSP emission inventories and dispersion model successfully predicted average annual TSP concentrations within the majority of the study area during the 1993-1994 study period, although there was a slight tendency to overpredict TSP in elevated terrain. Section 5.4 discusses technical factors influencing model predictions in elevated terrain.

TABLE 5.2.2-2
AVERAGE ANNUAL TSP PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		A Average Annual Predicted Concentration ($\mu g/m^3$)	B Average Annual Monitored Concentration ($\mu g/m^3$)	C Average Annual Predicted Concentration (with background[1]) ($\mu g/m^3$)	D Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	11.0	60.3	53.0	Within 2
	2	61.7	137	103.7	Within 2
	7	14.2	26.3	56.2	> 2
Far-field Sites	3	2.5	50.5	44.5	Within 2
	4	3.6	46.1	45.6	Within 2
	5	2.2	33.0	44.2	Within 2
Background	6	0.2	32.0	NA	NA

Arithmetic average background concentration = 42 $\mu g/m^3$.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

5.2.2.2 Total Fluorides

Total fluorides, as modeled in this study, represent non-specific gaseous and particulate fluorides. This was necessary since the majority of available source information was non-specific as to the form of the fluorides. Both gaseous and particulate fluorides were analyzed in the monitoring program. Particulate fluorides were measured in TSP particulate filter samples and gaseous fluorides were measured using NIOSH sampling methods at sites 1, 2, 6, and 7. Gaseous fluorides were not monitored at sites 3, 4, and 5; however, particulate fluoride was measured at these sites on TSP filters. Thus, total fluoride concentrations were not calculated

from the monitoring data at sites 3, 4, and 5. The IDL for particulate fluorides was 1.3 $\mu g/m^3$, while the gaseous fluoride IDL was 0.1 $\mu g/m^3$. In previous reports of monitoring data to EPA, the particulate and gaseous fluoride results were summed and referred to as total fluorides. This convention is continued in this study.

Total fluoride isopleths are shown in Figure 5.2.2-3. The predicted maximum ground level impact occurred just north of Simplot's main facility. Decreasing concentrations extend outward from the predicted maximum impact area. The predicted highest average annual concentration (without background added) was 3.3 $\mu g/m^3$, while the highest average annual monitored concentration was 3.7 $\mu g/m^3$ (Site 2). Both values are less than the EPA screening level (8.3 $\mu g/m^3$). With the addition of the arithmetic average background concentration of total fluoride (1.6 $\mu g/m^3$), the predicted highest average annual total fluoride concentration (4.9 $\mu g/m^3$) was within a factor of two of the highest average monitored concentration.

Table 5.2.2-3 summarizes model predictions for total fluoride at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background concentrations, were within a factor of two of monitored levels) at all sites at which total fluoride comparisons can be made. The average annual total fluoride emission inventories and dispersion model successfully predicted average annual total fluoride concentrations within the EMF site study area during the 1993-1994 study period.

TABLE 5.2.2-3
AVERAGE ANNUAL TOTAL FLUORIDE PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		A Average Annual Predicted Concentration ($\mu g/m^3$)	B Average Annual Monitored Concentration ($\mu g/m^3$)	C Average Annual Predicted Concentration (with background[1]) ($\mu g/m^3$)	D Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	0.5	3.4	2.1	Within 2
	2	2.2	3.7	3.8	Within 2
	7	1.7	3.0	3.3	Within 2
Far-field Sites	3	0.2	Total fluorides not measured	1.8	NA
	4	0.4	Total fluorides not measured	2.0	NA
	5	0.2	Total fluorides not measured	1.8	NA
Background	6	0.0	1.6	NA	NA

Arithmetic average background concentration = 1.6 $\mu g/m^3$.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

5.2.2.3 Metals

Model isopleths for metals, total phosphorus, and total silica are shown in Figures 5.2.2-4 through 5.2.2-12.

Antimony isopleths are shown in Figure 5.2.2-4. The predicted maximum ground level impact occurred north of BAPCO. Decreasing concentrations extend outward from the predicted maximum impact area. The predicted highest average annual concentration was 4.79E-3 $\mu g/m^3$; this is less than the EPA screening level (1.5 $\mu g/m^3$). Antimony was not analyzed in the monitoring program.

Arsenic isopleths are shown in Figure 5.2.2-5. The predicted maximum ground level impact occurred just north of FMC's main plant entrance. Decreasing concentrations extend outward from the predicted maximum impact area. The predicted concentration was below the IDL at the far-field monitoring sites (3, 4, and 5). The predicted highest average annual concentration was 1.82E-3 $\mu g/m^3$; this is comparable with the highest average monitored concentration of 1.27E-3 $\mu g/m^3$ (Site 2) and above the EPA screening level (5.7E-04 $\mu g/m^3$). With the addition of the arithmetic average background concentration of arsenic (5.1E-04 $\mu g/m^3$), the predicted highest average annual arsenic concentration (2.3E-03 $\mu g/m^3$) is within a factor of two of the highest average monitored concentration.

Table 5.2.2-4 summarizes model predictions for arsenic at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background concentrations, were within a factor of two of monitored levels) at all monitoring sites. This indicates that the average annual arsenic emission inventories and dispersion model successfully predicted average annual arsenic concentrations within the study area during the 1993-1994 study period.

TABLE 5.2.2-4
AVERAGE ANNUAL ARSENIC PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		A Average Annual Predicted Concentration ($\mu g/m^3$)	B Average Annual Monitored Concentration ($\mu g/m^3$)	C Average Annual Predicted Concentration (with background[1]) ($\mu g/m^3$)	D Model (with background) to Monitoring Comparison[2]
Near- field Sites	1	2.1E-04	6.53E-04	7.24E-04	Within 2
	2	1.3E-03	1.27E-03	1.8E-03	Within 2
	7	3.1E-04	5.30E-04	8.2E-04	Within 2
Far- field Sites	3	5.9E-05	5.63E-04	5.7E-04	Within 2
	4	7.8E-05	6.17E-04	5.9E-04	Within 2
	5	5.7E-05	5.50E-04	5.7E-04	Within 2
Background	6	5.9E-06	5.02E-04	NA	NA

Arithmetic average background concentration = 5.1E-04 $\mu g/m^3$.
[1]The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

No beryllium isopleths are shown in Figure 5.2.2-6 because all model predictions were below the IDL. The predicted maximum ground level impact occurred just north of FMC's main plant entrance. The predicted highest average annual concentration was 1.06E-5 $\mu g/m^3$. This was two orders of magnitude below the EPA screening level of 1.0E-3 $\mu g/m^3$. Beryllium was not detected at the background site. Hence, no background level of beryllium was added to the highest average annual predicted concentration in evaluating model performance.

Beryllium was not detected during the monitoring program (at an IDL of 1.7E-04 $\mu g/m^3$) except in 9 of 46 samples collected at Site 2. The average concentration in these 9 samples was 2.0E-04 $\mu g/m^3$. If the IDL were substituted for non-detected results in computing the average beryllium concentration in these 46 samples, the average concentration would be 1.77E-04 $\mu g/m^3$. Both values are greater than the highest average annual predicted value, but below the EPA screening level.

Table 5.2.2-5 summarizes model predictions of beryllium at each monitoring location and compares these results with observed data. Both the monitoring data and model predictions indicate that the average annual concentration of beryllium was below detection levels at all sites except Site 2. At Site 2, the model underpredicted the average annual beryllium concentration. Model performance meets EPA criteria at all sites except Site 2, where beryllium was observed near its detection level in 9 of 46 samples. This indicates that the average annual beryllium emission inventories and dispersion model were generally successfully in predicted average annual beryllium concentrations within the study area during the 1993-1994 study period, with a slight tendency to underpredict at a near-field site.

TABLE 5.2.2-5
AVERAGE ANNUAL BERYLLIUM PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		A	B	C	D
		Average Annual Predicted Concentration ($\mu g/m^3$)	**Average Annual Monitored Concentration[3] ($\mu g/m^3$)**	**Average Annual Predicted Concentration (with background[1]) ($\mu g/m^3$)**	**Model (with background) to Monitoring Comparison[2]**
Near-field Sites	1	1.7E-06 (<IDL)	Not detected	<IDL	Agree @ ND
	2	8.4E-06 (<IDL)	1.77E-04	<IDL	<2
	7	3.1E-06 (<IDL)	Not detected	<IDL	Agree @ ND
Far-field Sites	3	5.2E-07 (<IDL)	Not detected	<IDL	Agree @ ND
	4	6.8E-07 (<IDL)	Not detected	<IDL	Agree @ ND
	5	4.5E-07 (<IDL)	Not detected	<IDL	Agree @ ND
Background	6	4.9E-08 (<IDL)	Not detected	NA	NA

Beryllium not detected at Sites 1, 7, 3, 4, 5, and 6 at IDL = 1.7E-04 $\mu g/m^3$.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

Cadmium isopleths are shown in Figure 5.2.2-7. The predicted maximum ground level impact occurred near monitoring Site 2. Decreasing concentrations extend outward from the predicted maximum impact area. The predicted highest average annual concentration was 7.75E-3 $\mu g/m^3$.

This was above the EPA screening level of 1.4E-3 $\mu g/m^3$ and slightly below the highest average monitored concentration of 1.16E-2 $\mu g/m^3$ (Site 2). The predicted concentration was below both the IDL and the EPA screening level at the far-field monitoring sites (3, 4, and 5).

Table 5.2.2-6 summarizes model predictions of cadmium at each monitoring location and compares these results with observed data. Cadmium was not detected at the background monitoring site at an IDL of 1.3E-3 $\mu g/m^3$. Consequently, the predicted average annual cadmium concentrations were not adjusted by the addition of an arithmetic average background concentration of cadmium.

Table 5.2.2-6 shows that model performance meets EPA criteria (i.e., model predictions were within a factor of two of monitored levels) at Sites 1, 2, 7, and 4. The model underpredicted the average annual cadmium concentration at Site 3 by a factor of 0.4 and at Site 5 by a factor of 0.2, compared with the target range of a factor between 0.5 to 2. However, the average annual monitored concentrations of cadmium at both sites (2.2E-03 $\mu g/m^3$) were near the IDL. Cadmium was not detected in 27 of the 46 samples collected at Site 3 and in 31 of the 45 samples collected at Site 5. Consequently, the slight underprediction of cadmium at this site is not considered to be a significant issue in model performance.

TABLE 5.2.2-6
AVERAGE ANNUAL CADMIUM PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		A	B	C	D
		Average Annual Predicted Concentration ($\mu g/m^3$)	Average Annual Monitored Concentration ($\mu g/m^3$)	Average Annual Predicted Concentration (with background[1]) ($\mu g/m^3$)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	2.0E-03	2.6E-03	2.0E-03	Within 2
	2	7.4E-03	1.2E-02	7.4E-03	Within 2
	7	3.6E-03	2.6E-03	3.6E-03	Within 2
Far-field Sites	3	6.7E-04	1.7E-03	6.7E-04	<2
	4	7.8E-04	1.5E-03	7.8E-04	Within 2
	5	5.3E-04	2.2E-03	5.3E-04	<2
Background	6	6.1E-05	Not detected	NA	NA

Cadmium was not detected in background samples at an IDL = 1.3E-03 $\mu g/m^3$.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

Total chromium isopleths are shown in Figure 5.2.2-8. The predicted maximum ground level impact occurred just north of FMC's ore stockpiles. Decreasing concentrations extend outward from the predicted maximum impact area. The predicted highest average annual concentration was 5.75E-2 $\mu g/m^3$; this was above the highest average monitored concentration of 1.74E-2 $\mu g/m^3$ (Site 2). With the addition of the arithmetic average background concentration of total chromium (2.0E-04 $\mu g/m^3$), the predicted highest average annual total chromium concentration (5.77E-02 $\mu g/m^3$) was 3.3 times greater than the highest average monitored concentration.

The EPA screening level, which is based on toxicity values for hexavalent chromium, is not relevant to total chromium because less than 1% of the total chromium emitted from the facilities is in a hexavalent form (Appendix AK).

Table 5.2.2-7 summarizes model predictions of total chromium at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria at Sites 1, 3, and 5 (i.e., model predictions, after addition of background concentrations, were within a factor of two of monitored levels). The model overpredicted total chromium by factors of 9.7, 2.8, and 2.6 at Sites 7, 4, and 2, respectively. This indicates that the average annual total chromium emission inventories and dispersion model were not successful in predicting average annual total chromium concentrations within the study area during the 1993-1994 study period, with a significant overprediction in elevated terrain. (Reference Section 5.4 for discussion of model performance in elevated terrain.)

TABLE 5.2.2-7
AVERAGE ANNUAL TOTAL CHROMIUM PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		A	B	C	D
		Average Annual Predicted Concentration ($\mu g/m^3$)	**Average Annual Monitored Concentration ($\mu g/m^3$)**	**Average Annual Predicted Concentration (with background[1]) ($\mu g/m^3$)**	**Model (with background) to Monitoring Comparison[2]**
Near-field Sites	1	6.4E-03	4.0E-03	6.6E-03	Within 2
	2	4.5E-02	1.7E-02	4.5E-02	>2
	7	9.5E-03	1.0E-03	9.7E-03	>2
Far-field Sites	3	1.6E-03	9.3E-04	1.8E-03	Within 2
	4	2.4E-03	9.4E-04	2.6E-03	>2
	5	1.7E-03	2.2E-03	1.9E-03	Within 2
Background	6	1.7E-04	2.8E-04	NA	NA

Arithmetic Average background = 2.0E-04 $\mu g/m^3$.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

Lead isopleths are shown in Figure 5.2.2-9. The predicted maximum ground level impact occurred just west of FMC's main plant entrance. Decreasing concentrations extend outward from the predicted maximum impact area. The predicted highest average annual concentration was 2.31E-3 $\mu g/m^3$; this is approximately three orders of magnitude below the EPA screening level of 1.5 $\mu g/m^3$. Lead was not analyzed in the monitoring program.

Nickel isopleths are shown in Figure 5.2.2-10. The predicted maximum ground level impact occurred just north of FMC's main plant entrance. Decreasing concentrations extend outward from the predicted maximum impact area. The predicted highest average annual concentration was 1.08E-2 $\mu g/m^3$. This was slightly above the EPA screening level of 1.0E-02 $\mu g/m^3$ and also above the highest average monitored concentration of 4.85 E-3 $\mu g/m^3$ (Site 2). Nickel was not detected (at an IDL of 3.3E-03 $\mu g/m^3$) at the background site and Sites 7, 4, and 5. Thus, background was not added to the predicted nickel concentration in evaluating model performance. The predicted highest average annual nickel concentration was 2.2 times greater than the highest average monitored concentration.

The predicted concentrations of nickel were above the IDL only within the area just north of the FMC and Simplot operations area; they were below the IDL at Sites 1 and 7 and the far-field and background monitoring sites (3, 4, 5, and 6).

Table 5.2.2-8 summarizes model predictions of nickel at each monitoring location and compares these results with observed data. No background adjustment was made to the predicted concentrations because nickel was not detected in background samples. It shows that model performance meets EPA criteria (i.e., model predictions were within a factor of two of monitored levels) at Sites 2 and 7. Model performance was also acceptable at monitoring Sites 4 and 5, in that the model predicted undetectable levels of nickel, which was confirmed by the monitoring data. Nickel concentrations were underpredicted, however, at Sites 1 and 3 by factors of 0.4 and 0.1, respectively. However, the average annual monitored concentration of nickel at these sites (3.5E-03 and 3.4E-03 $\mu g/m^3$, respectively) are near the IDL. In fact, nickel was not detected in

26 and 29 of the 33 samples collected at Sites 1 and 3, respectively, that were analyzed for nickel. Consequently, the slight underprediction of nickel at these sites is not considered to be a significant issue in model performance. This indicates that the average annual nickel emission inventories and dispersion model were successful in predicted average annual nickel concentrations within the study area during the 1993-1994 study period.

TABLE 5.2.2-8
AVERAGE ANNUAL NICKEL PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		A	B	C	D
		Average Annual Predicted Concentration ($\mu g/m^3$)	Average Annual Monitored Concentration ($\mu g/m^3$)	Average Annual Predicted Concentration (with background[1]) ($\mu g/m^3$)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	1.3E-03	3.5E-03	1.3E-03	<2
	2	8.7E-03	4.9E-03	8.7E-03	Within 2
	7	1.9E-03	Not detected	1.9E-03	Within 2
Far-field Sites	3	3.2E-04	3.4E-03	3.2E-04	<2
	4	4.7E-04	Not detected	4.7E-04	Agree @ ND
	5	3.3E-04	Not detected	3.3E-04	Agree @ ND
Background	6	3.3E-05	Not detected	3.3E-05	Agree @ ND

Nickel not detected at Sites 7, 4, 5, and 6 at IDL = 3.3E-03 $\mu g/m^3$.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

Total phosphorus isopleths are shown in Figure 5.2.2-11. The predicted maximum ground level impact occurred just northwest of the FMC ore stockpiles. Decreasing concentrations extend outward from the predicted maximum impact area. The predicted highest average annual concentration was 3.0 $\mu g/m^3$. This was above the EPA screening level of 0.3 $\mu g/m^3$, but below the highest average monitored concentration of 5.51 $\mu g/m^3$ (Site 2).

Table 5.2.2-9 summarizes model predictions of total phosphorus at each monitoring location and compares these results with observed data. Total phosphorus was not detected in the background samples at an IDL of 0.2 $\mu g/m^3$. It was detected in 2 out of 50 samples collected at Site 4, at an average concentration of 0.3 $\mu g/m^3$. No adjustment was made to the model predictions for the inclusion of background.

Review of Table 5.2.2-9 shows that model performance for total phosphorus predictions meets EPA criteria at Sites 3, 4, and 7. The model underpredicted total phosphorus at Sites 1 and 2 by a factor of 0.4 and at Site 5 by a factor of 0.2. This indicates that the average annual total phosphorus impacts slightly underpredicted average annual monitored total phosphorus concentrations within the study area during the 1993-1994 study period.

TABLE 5.2.2-9
AVERAGE ANNUAL TOTAL PHOSPHORUS PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		A	B	C	D
		Average Annual Predicted Concentration ($\mu g/m^3$)	**Average Annual Monitored Concentration ($\mu g/m^3$)**	**Average Annual Predicted Concentration (with background[1]) ($\mu g/m^3$)**	**Model (with background) to Monitoring Comparison[2]**
Near-field Sites	1	0.4	1.0	0.4	<2
	2	2.2	5.6	2.2	<2
	7	0.6	0.4	0.6	Within 2
Far-field Sites	3	0.1 (<IDL)	0.3	0.1	Within 2
	4	0.1 (<IDL)	0.3	0.1	Within 2
	5	0.1 (<IDL)	0.5	0.1	<2
Background	6	0.0 (<IDL)	Not Detected	NA	NA

Total Phosphorus was not detected at Sites 4 and 6 at an IDL of 0.2 $\mu g/m^3$.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

Total silica isopleths are shown in Figure 5.2.2-12. The predicted maximum ground level impact occurred just north of FMC's ore stockpiles. Decreasing concentrations extend outward from the

predicted maximum impact area. The predicted highest average annual concentration was 4.52 $\mu g/m^3$. No screening level was provided by the EPA for total silica. A form of silica, crystalline silica (e.g., quartz), was analyzed in the monitoring program. However, crystalline silica cannot be readily compared with total silica.

5.2.2.4 Radionuclides

Model isopleths for radionuclides are shown in Figures 5.2.2-13 through 5.2.2-21.

Lead-210 isopleths are shown in Figure 5.2.2-13. The predicted maximum ground level impact occurred north of BAPCO. Decreasing activities extend outward from the predicted maximum impact area. The predicted highest average annual activity was 1.23E-3 pCi/m^3. This was just above the EPA screening level of 1.2E-3 pCi/m^3 but below the highest average monitored activity of 2.45E-2 pCi/m^3 (Site 2) and the arithmetic average background activity (1.7E-02 pCi/m^3). The isopleth corresponding to the IDL was predicted to occur in the area between the FMC and BAPCO facilities and Interstate 86.

Table 5.2.2-10 summarizes model predictions of lead-210 at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background activities, were within a factor of two of monitored levels) at all monitoring sites. This indicates that the average annual lead-210 emission inventories and dispersion model successfully predicted average annual lead-210 activities within the study area during the 1993-1994 study period.

TABLE 5.2.2-10
AVERAGE ANNUAL LEAD-210 PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		Average Annual Predicted Concentration (pCi/m^3)	Average Annual Monitored Concentration (pCi/m^3)	Average Annual Predicted Concentration (with background[1]) (pCi/m^3)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	1.3E-04	2.4E-02	1.7E-02	Within 2
	2	6.4E-04	2.4E-02	1.7E-02	Within 2
	7	1.6E-04	2.1E-02	1.7E-02	Within 2
Far-field Sites	3	3.3E-05	2.5E-02	1.7E-02	Within 2
	4	4.6E-05	2.4E-02	1.7E-02	Within 2
	5	3.7E-05	2.2E-02	1.7E-02	Within 2
Background	6	3.3E-06	2.3E-02	NA	NA

Arithmetic average activity in background samples = 1.7E-02 pCi/m^3.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

Polonium-210 isopleths are shown in Figure 5.2.2-14. The predicted maximum ground level impact occurred just north of Simplot's main facility. Decreasing activities extend outward from the predicted maximum impact area. The predicted highest average annual activity was 1.05E-1 pCi/m^3. This was above the EPA screening level of 1.8E-3 pCi/m^3 and above the highest average monitored activity of 6.92E-2 pCi/m^3 (Site 2). A closed isopleth (secondary maximum) occurred north of BAPCO at an activity of 5.0E-2 pCi/m^3.

Table 5.2.2-11 summarizes model predictions of polonium-210 at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background activities, were within a factor of two of monitored levels) at Sites 2, 3, 4, and 5. Polonium-210 activities were overpredicted at Sites 1 and 7 by factors of 2.07 and 4.9 respectively. The overprediction at Site 1 was barely beyond the target range of a factor between 0.5 to 2.

The greatest overprediction (a factor of 4.9) occurred for Site 7, which is in elevated terrain. This overprediction may be attributable to the limitations of modeling impacts in elevated terrain rather than an indication that polonium-210 emissions are overstated in the emission inventories. (Reference Section 5.4 for further discussion.) This indicates that the average annual polonium-210 emission inventories and dispersion model were generally successful in predicting average annual polonium-210 activities within the study area during the 1993-1994 study period, with a tendency to overpredict in elevated terrain.

TABLE 5.2.2-11
AVERAGE ANNUAL POLONIUM-210 PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		Average Annual Predicted Concentration (pCi/m^3)	Average Annual Monitored Concentration (pCi/m^3)	Average Annual Predicted Concentration (with background[1]) (pCi/m^3)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	2.7E-02	1.5E-02	3.1E-02	>2
	2	6.4E-02	6.9E-02	6.8E-02	Within 2
	7	6.9E-02	1.5E-02	7.3E-02	>2
Far-field Sites	3	1.1E-02	1.2E-02	1.5E-02	Within 2
	4	1.2E-02	8.7E-03	1.6E-02	Within 2
	5	6.1E-03	1.5E-02	1.1E-02	Within 2
Background	6	9.0E-04	6.7E-03	NA	NA

Arithmetic average in background samples = 4.4E-03 pCi/m^3.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

No radium-226 isopleths are shown in Figure 5.2.2-15 because all model predictions were below the IDL. The predicted maximum ground level impact occurred just north of FMC's main plant entrance. The highest predicted average annual activity was 4.63E-4 pCi/m^3; this is below both the EPA screening level of 1.6E-3 pCi/m^3 and the IDL. Radium-226 was detected in only two samples during the monitoring program and then at sites that were predominantly upwind from the EMF facilities during the sampling period (Bechtel, 1994g).

Table 5.2.2-12 summarizes model predictions of radium-226 at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background activities, were within a factor of two of monitored levels) at all sites. Both monitoring data and model predictions indicate that the average annual activity of radium-226 was below detection levels at all sites except Site 2. Model predictions were within a factor of two of observed activities at Site 2. This indicates that the average annual radium-226 emission inventories and dispersion model successfully predicted average annual radium-226 activities within the study area during the 1993-1994 study period.

TABLE 5.2.2-12
AVERAGE ANNUAL RADIUM-226 PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		Average Annual Predicted Concentration (pCi/m^3)	Average Annual Monitored Concentration (pCi/m^3)	Average Annual Predicted Concentration (with background[1]) (pCi/m^3)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	8.1E-05 (< IDL)	Not detected	8.1E-05	Agree @ ND
	2	4.1E-04 (< IDL)	5.4E-04	4.1E-04	Within 2
	7	1.4E-04 (< IDL)	Not detected	1.4E-04	Agree @ ND
Far-field Sites	3	2.3E-05 (< IDL)	Not detected	2.3E-05	Agree @ ND
	4	3.3E-05 (< IDL)	Not detected	3.3E-05	Agree @ ND
	5	2.2E-05 (< IDL)	Not detected	2.2E-05	Agree @ ND
Background	6	2.3E-06 (< IDL)	Not detected	NA	NA

Radium-226 not detected at Sites 1, 7, 3, 4, 5, and 6 at IDL = 5.3E-04 pCi/m^3.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

No radium-228 isopleths are shown in Figure 5.2.2-16 because all model predictions were below the IDL. The predicted maximum ground level impact occurred north of BAPCO. The highest predicted average annual activity was 4.73E-5 pCi/m^3. This is well below both the EPA screening level of 6.9E-3 pCi/m^3 and the IDL of 1.97E-3 pCi/m^3. Radium-228 was not detected in the monitoring program.

Table 5.2.2-13 summarizes model predictions of radium-228 at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria. Both the monitoring data and model predictions indicate that the average annual activity of radium-228 was below detection levels at all sites. This indicates that the average annual radium-228 emission inventories and dispersion model successfully predicted average annual radium-228 activities within the study area during the 1993-1994 study period.

TABLE 5.2.2-13
AVERAGE ANNUAL RADIUM-228 PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		Average Annual Predicted Concentration (pCi/m^3)	Average Annual Monitored Concentration (pCi/m^3)	Average Annual Predicted Concentration (with background[1]) (pCi/m^3)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	5.2E-06 (< IDL)	Not detected	5.2E-06	Agree @ ND
	2	2.2E-05 (< IDL)	Not detected	2.2E-05	Agree @ ND
	7	6.9E-06 (< IDL)	Not detected	6.9E-06	Agree @ ND
Far-field Sites	3	1.4E-06 (< IDL)	Not detected	1.4E-06	Agree @ ND
	4	1.9E-06(< IDL)	Not detected	1.9E-06	Agree @ ND
	5	1.5E-06 (< IDL)	Not detected	1.5E-06	Agree @ ND
Background	6	1.4E-07 (< IDL)	Not detected	NA	NA

Radium-228 was not detected in background samples at an IDL = 1.97E-3 pCi/m^3.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

Thorium-230 isopleths are shown in Figure 5.2.2-17. The predicted maximum ground level impact occurred near Site 2, just north of FMC's ore piles. Decreasing activities extend outward from the predicted maximum impact area. The highest predicted average annual activity was 6.54E-4 pCi/m^3. This is above the EPA screening level of 2.0E-4 pCi/m^3 and above the highest average monitored activity of 2.85E-4 pCi/m^3 (Site 2). The predicted activities at the far-field monitoring Sites (3, 4, and 5) were below the IDL.

Table 5.2.2-14 summarizes model predictions of thorium-230 at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background activities, were within a factor of two of monitored levels) at Site 1. Model predictions were greater than observed levels at Sites 2 and 7 by a factor of 2.3 and 3.2, respectively. Both monitoring data show and model predictions indicate that the average annual activity of thorium-230 was below detection levels at Sites 3, 4, and 5. The greatest overprediction occurred at the elevated terrain site, with a slight overprediction at Site 2. This indicates that the average annual thorium-230 emission inventories and dispersion model were generally successful in predicting the average annual thorium-230 activities within the study area during the 1993-1994 study period, with a tendency to overpredict activities in elevated terrain. (Reference Section 5.4 for a discussion of model performance in elevated terrain.)

TABLE 5.2.2-14
AVERAGE ANNUAL THORIUM-230 PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		Average Annual Predicted Activity (pCi/m^3)	Average Annual Monitored Activity (pCi/m^3)	Average Annual Predicted Activity (with background[1]) (pCi/m^3)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	1.1E-04 (< IDL)	1.0E-04	1.1E-04	Within 2
	2	6.6E-04 (< IDL)	2.85E-04	6.6E-04	>2
	7	1.3E-04 (< IDL)	3.99E-05	1.3E-04	>2
Far- field Sites	3	2.2E-05 (< IDL)	Not detected	2.2E-05	Agree @ ND
	4	3.3E-05 (< IDL)	Not detected	3.3E-05	Agree @ ND
	5	1.9E-05 (< IDL)	Not detected	1.9E-05	Agree @ ND
Background	6	2.1E-06 (< IDL)	Not detected	NA	NA

Thorium-230 not detected at Sites 3, 4, 5, and 6 at IDL = 3.5E-05 pCi/m^3.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

No thorium-232 isopleths are shown in Figure 5.2.2-18 because all model predictions were below the IDL. The predicted maximum ground level impact occurred north of BAPCO. The

highest predicted average annual activity was 4.73E-5 pCi/m^3. This is below the EPA screening level of 2.0E-4 pCi/m^3. Thorium-232 was detected only once during the monitoring program.

Table 5.2.2-15 summarizes model predictions of thorium-232 at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria. Both the monitoring data and model predictions indicate that the average annual activity of radium-228 was below detection levels at all sites. This indicates that the average annual thorium-232 emission inventories and dispersion model successfully predicted average annual thorium-232 activities within the study area during the 1993-1994 study period.

TABLE 5.2.2-15
AVERAGE ANNUAL THORIUM-232 PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		Average Annual Predicted Activity (pCi/m^3)	Average Annual Monitored Activity (pCi/m^3)	Average Annual Predicted Activity (with background[1]) (pCi/m^3)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	5.8E-06 (< IDL)	Not detected	5.8E-06	Agree @ ND
	2	2.8E-05 (< IDL)	Not detected[3]	2.8E-05	Agree @ ND
	7	6.5E-06 (< IDL)	Not detected	6.5E-06	Agree @ ND
Far-field Sites	3	1.3E-06 (< IDL)	Not detected	1.3E-06	Agree @ ND
	4	1.9E-06 (< IDL)	Not detected	1.9E-06	Agree @ ND
	5	1.5E-06 (< IDL)	Not detected	1.5E-06	Agree @ ND
Background	6	1.3E-07 (< IDL)	Not detected	NA	NA

Thorium-232 not detected in background samples at IDL = 4.1E-05 pCi/m^3.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.
[3]Detected once at 2.1E-04 pCi/m^3, out of 23 samples collected at this site.

Uranium-234 isopleths are shown in Figure 5.2.2-19. The predicted maximum ground level impact occurred just north of FMC's main plant entrance. Decreasing activities extend outward from the predicted maximum impact area. The predicted highest average annual activity was 3.78E-4 pCi/m^3. This is slightly above the EPA screening level of 2.0E-4 pCi/m^3, but slightly below the highest average monitored activity of 4.04E-4 pCi/m^3 (Site 2).

Table 5.2.2-16 summarizes model predictions of uranium-234 at each monitoring location and compares these results with observed data. It shows that model performance did not meet EPA criteria (i.e., model predictions, after addition of background concentrations, were greater than a factor of two of monitored levels) at sites 7, 3, and 4 by factors of 5.9, 2.3, and 3.4, respectively. This indicates that the average annual uranium-234 emission inventories and dispersion model overpredicted average annual uranium-234 emissions within the study area during the 1993-1994 study period. The largest overprediction occurred at the elevated terrain receptor. (Reference Section 5.4 for a discussion of model performance in elevated terrain.)

TABLE 5.2.2-16
AVERAGE ANNUAL URANIUM-234 PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		Average Annual Predicted Activity (pCi/m^3)	Average Annual Monitored Activity (pCi/m^3)	Average Annual Predicted Activity (with background[1]) (pCi/m^3)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	7.4E-05	9.7E-05	8.3E-05	Within 2
	2	3.5E-04	4.0E-04	3.6E-04	Within 2
	7	1.2E-04	2.2E-05	1.3E-04	>2
Far-field Sites	3	1.9E-05	1.2E-05	2.8E-05	>2
	4	2.8E-05	1.1E-05	3.7E-05	>2
	5	1.8E-05	2.6E-05	2.7E-05	Within 2
Background	6	1.9E-06	1.2E-05	NA	NA

Arithmetic average in background samples = 9.3E-06 pCi/m^3.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

Uranium-235 isopleths are shown in Figure 5.2.2-20. The predicted maximum ground level impact occurred just north of FMC's main plant entrance. Decreasing activities extend outward from the predicted maximum impact area. The predicted highest average annual activity was 1.61E-5 pCi/m^3. This is below the EPA screening level of 2.0E-4 pCi/m^3 and is slightly below the highest average monitored activity of 1.85E-5 pCi/m^3 (Site 2).

Table 5.2.2-17 summarizes model predictions of uranium-235 at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background concentrations, were within a factor of two of monitored levels) at Sites 1, 2, and 5. The model overpredicted uranium-235 at Sites 7, 3, and 4 by factors of 5.2, 2.2, and 3.0, respectively. These results indicate that the average annual uranium-235 emission inventories and dispersion model results overpredicted average annual uranium-235 activities within the study area during the 1993-1994 study period. The largest overprediction occurred at the elevated terrain receptor. (Reference Section 5.4 for a discussion of model performance in elevated terrain.)

TABLE 5.2.2-17
AVERAGE ANNUAL URANIUM-235 PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		Average Annual Predicted Activity (pCi/m^3)	Average Annual Monitored Activity (pCi/m^3)	Average Annual Predicted Activity (with background[1]) (pCi/m^3)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	2.9E-06	4.4E-06	3.3E-06	Within 2
	2	1.5E-05	1.9E-05	1.6E-05	Within 2
	7	4.7E-06	9.8E-07	5.1E-06	>2
Far-field Sites	3	8.1E-07	5.5E-07	1.2E-06	>2
	4	1.1E-06	5.0E-07	1.5E-06	>2
	5	7.4E-07	1.2E-06	1.2E-06	Within 2
Background	6	7.9E-08	5.4E-07	NA	NA

Arithmetic average in background samples = 4.1E-07 pCi/m^3.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

Uranium-238 isopleths are shown in Figure 5.2.2-21. The predicted maximum ground level impact occurred just north of FMC's main plant entrance. Decreasing activities extend outward from the predicted maximum impact area. The predicted highest average annual activity was 4.70E-4 pCi/m^3. This is slightly above both the EPA screening level of 1.0E-4 pCi/m^3 and the highest average monitored activity of 3.80E-4 pCi/m^3 (Site 2).

Table 5.2.2-18 summarizes model predictions of uranium-238 at each monitoring location and compares these results with observed data. It shows that model performance meets EPA criteria (i.e., model predictions, after addition of background activity, were within a factor of two of monitored levels) at Sites 1, 2, and 5. The model overpredicted uranium-235 at Sites 7, 3, and 4 by factors of 6.5, 2.6, and 3.7, respectively. This indicates that the average annual uranium-238 emission inventories and dispersion model results overpredicted average annual uranium-238 activities within the study area during the 1993-1994 study period. The largest overprediction occurred at the elevated terrain receptor. (Reference Section 5.4 for a discussion of model performance in elevated terrain.)

TABLE 5.2.2-18
AVERAGE ANNUAL URANIUM-238 PREDICTIONS AND COMPARISON WITH MONITORING RESULTS

Site		Average Annual Predicted Concentration (pCi/m^3)	Average Annual Monitored Concentration (pCi/m^3)	Average Annual Predicted Concentration (with background[1]) (pCi/m^3)	Model (with background) to Monitoring Comparison[2]
Near-field Sites	1	8.6E-05	9.1E-05	9.5E-05	Within 2
	2	4.7E-04	3.8E-04	4.8E-04	Within 2
	7	1.2E-04	2.0E-05	1.3E-04	>2
Far-field Sites	3	2.0E-05	1.1E-05	2.9E-05	>2
	4	2.8E-05	1.0E-05	3.7E-05	>2
	5	1.8E-05	2.5E-05	2.7E-05	Within 2
Background	6	1.9E-06	1.1E-05	NA	NA

Arithmetic average activity in background samples = 8.7E-06 pCi/m^3.
[1] The arithmetic average of samples collected at Site 6 when it was predominantly upwind of the EMF facilities.
[2] Within 2 = Within a factor of 2.
>2 = Average annual modeled level is greater than twice the average annual monitored level.
<2 = Average annual modeled level is less than one-half the average annual monitored level.

5.2.3 General Observations Concerning Predicted Average Annual Constituent Levels

Five general observations were noted with the analysis of model predictions of the average annual constituent concentrations (or activities):

1. The isopleths exhibit, to varying degrees, a pattern similar to the shape of butterfly wings, with decreasing concentrations (or activities) spreading outwards from the common northern boundary of the industrial operations area of the FMC and Simplot plants. This pattern is typically elongated along the northwest axis, particularly for the following constituents: cadmium, polonium-210, and total fluorides.

2. The highest-predicted average annual concentrations (or activities) of PM_{10}, TSP, total fluorides, metals, and radionuclides occurred in an area north of the facilities, either between the fenceline of the industrial operations area and Highway 30 or along the right-of-way of Interstate 86 the north of BAPCO. These points of maximum impact are undeveloped and unoccupied, and are expected to remain in this condition. The highest predicted average annual constituent concentration (or activity) occurred at one of four model grid positions within this area, depending upon the specific constituent.

3. The highest-predicted average annual constituent concentrations (or activities) are between 100 and 1,000 times below concentrations (or activities) that would be of concern in an industrial or commercial workplace.

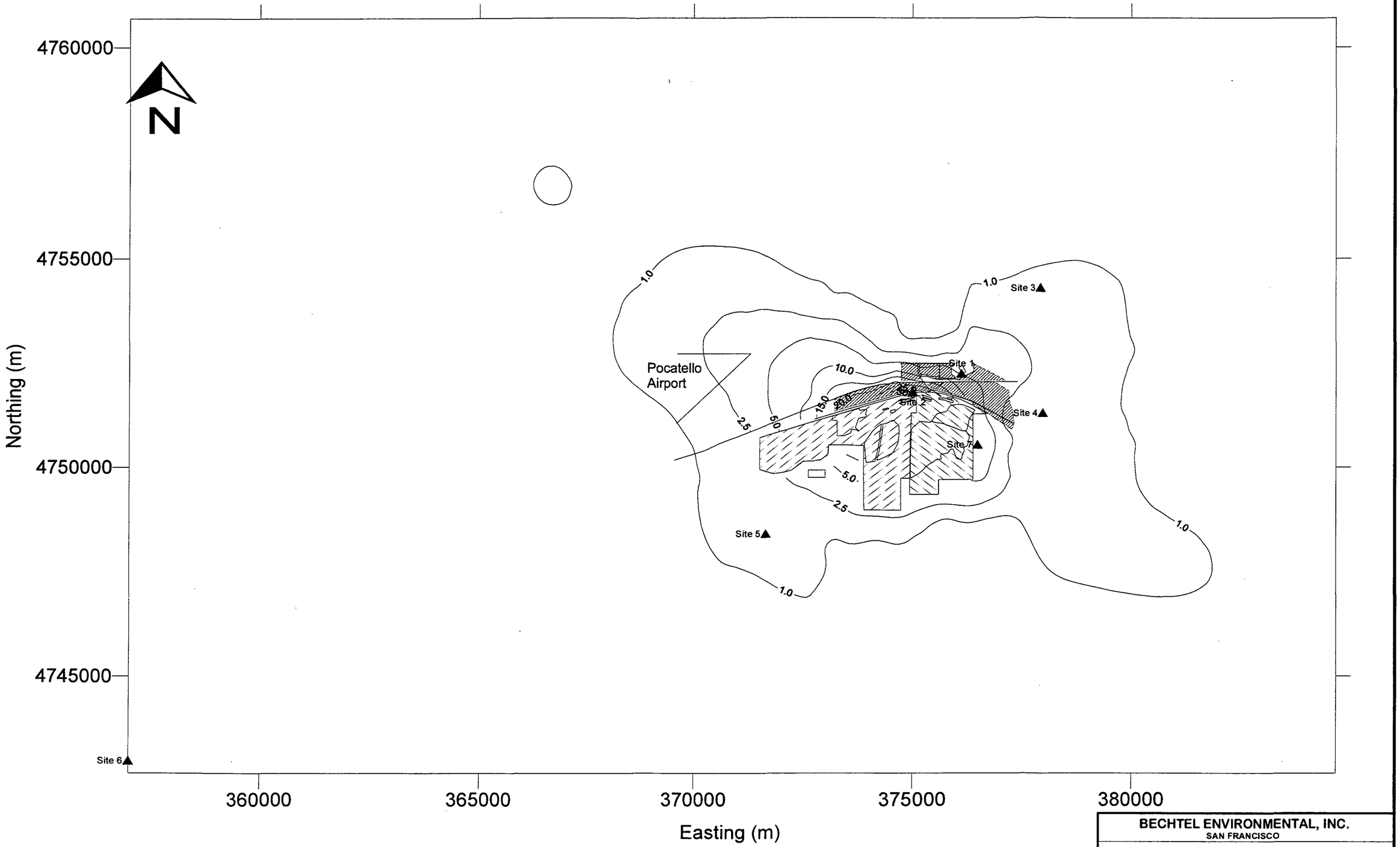
4. Model performance meets EPA criteria for 15 of the 18 constituents for which model predictions can be compared with monitoring data. The highest average annual, as well as the average annual predicted levels of PM_{10}, TSP, total fluorides, arsenic, cadmium, lead-210, and polonium-210 (after addition of background levels) were within a factor of two of observed levels at most monitoring sites. The highest predicted average annual activities of uranium-234, -235, and -238 were within a factor of two of observed levels, although the average annual levels of these constituents were overpredicted at several monitoring sites. Average annual model predicted concentrations (or activities) of beryllium, radium-226 and -228, and thorium-232 were below detection levels, consistent with monitoring observations.

5. The highest average annual concentrations of total chromium and nickel and the activity of thorium-230 were overpredicted. The overpredictions may be attributable to an overstatement of emissions of these constituents from several fugitive dust sources. While the highest predicted average annual concentration of total phosphorus met EPA

criteria, the average annual concentration of total phosphorus was slightly underpredicted at several of the monitoring sites.

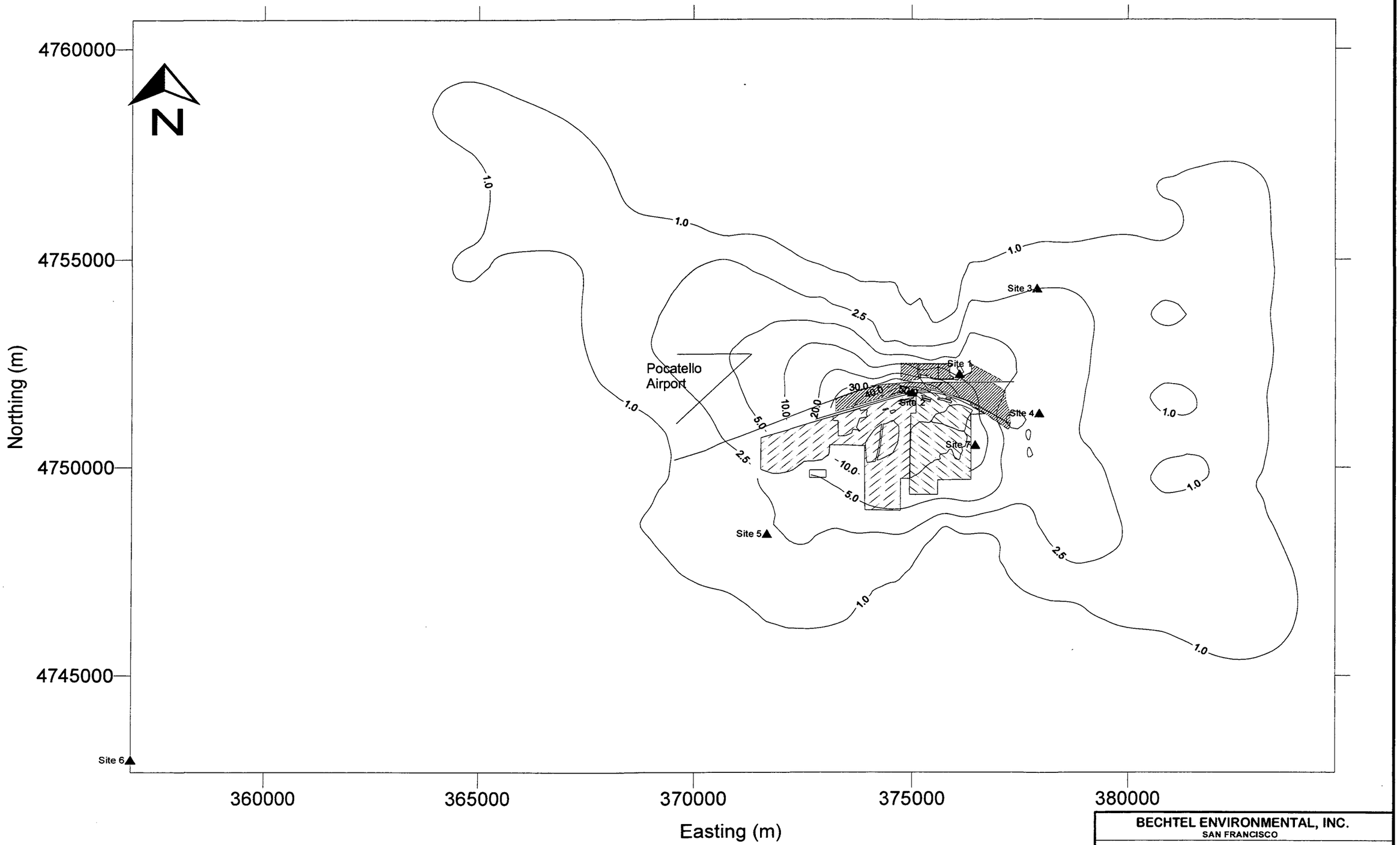
6. The average annual concentrations (or activities) of TSP, total chromium, polonium-210, uranium-234, -235, and -238 were overpredicted at Site 7. This site is in elevated terrain, and these overpredictions are likely attributable to a limitation of atmospheric dispersion modeling in elevated terrain, rather than to an overstatement of emission levels. Section 5.4 presents further discussion on this subject.

Air Modeling Report
Figures for Section 5.2



Background Level = 15 µg/m3
Highest Modeled Average Annual (without background) = 40.1 µg/m3

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Average Annual PM10 Concentrations (µg/m3)		
JOB No.	DRAWING No.	REV
21372	FIGURE 5.2.2-1	O



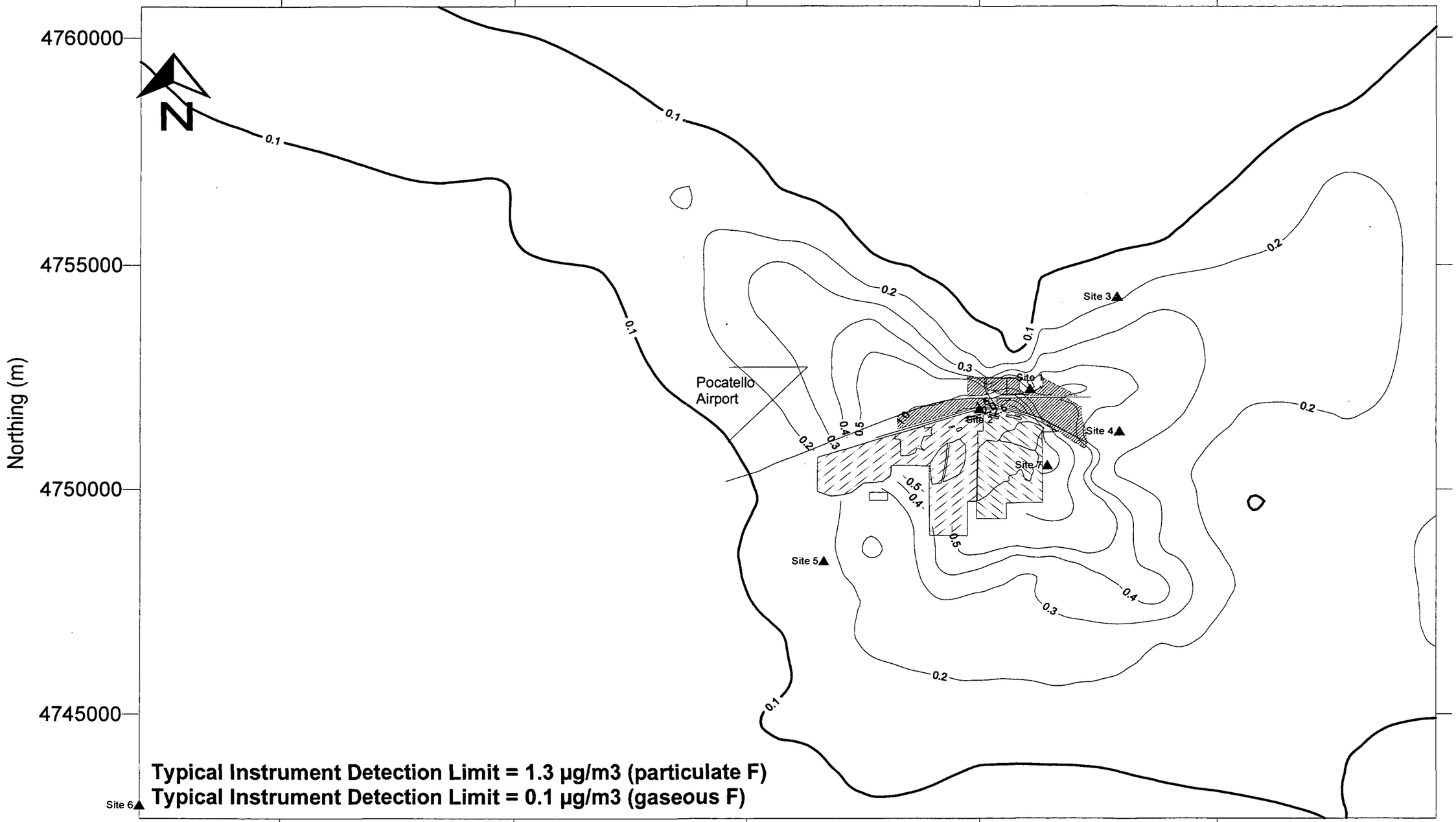
Background Level = 42 µg/m3
Highest Modeled Average Annual (without background) = 74.1 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual TSP Concentrations (µg/m3)

JOB No.	DRAWING No.	REV
21372	FIGURE 5.2.2-2	O



Typical Instrument Detection Limit = 1.3 µg/m3 (particulate F)
Typical Instrument Detection Limit = 0.1 µg/m3 (gaseous F)

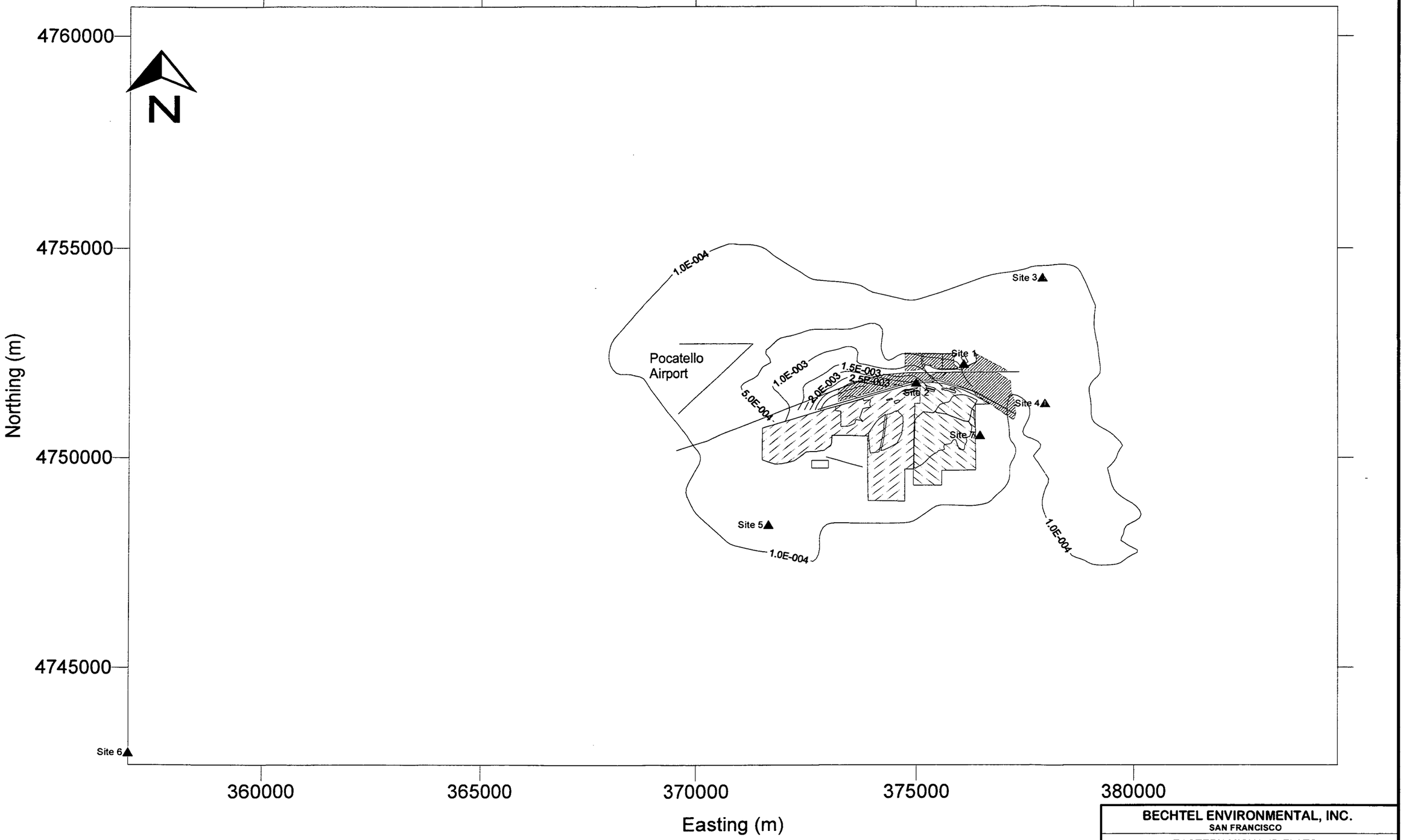
EPA Screening Level = 8.3 µg/m3
Background Level = 1.6 µg/m3
Highest Modeled Average Annual (without background) = 3.34 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Total Fluorides Concentrations (µg/m3)

JOB No.	DRAWING No.	REV
21372	FIGURE 5.2.2-3	O



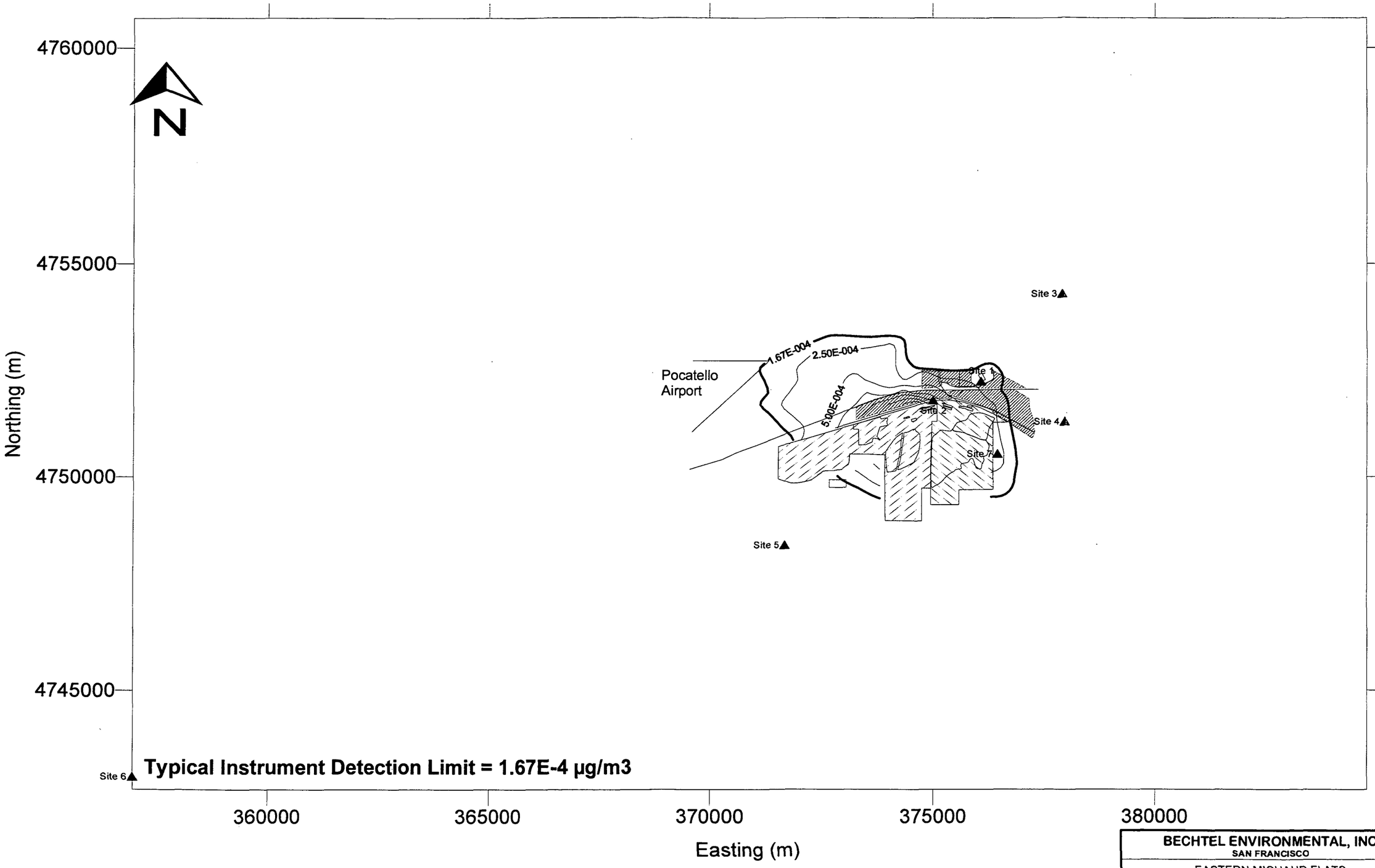
EPA Screening Level = 1.5 µg/m3
Background Level Not Monitored
Highest Modeled Average Annual (without background) = 4.79E-3 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Antimony Concentrations (µg/m3)

JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-4	O



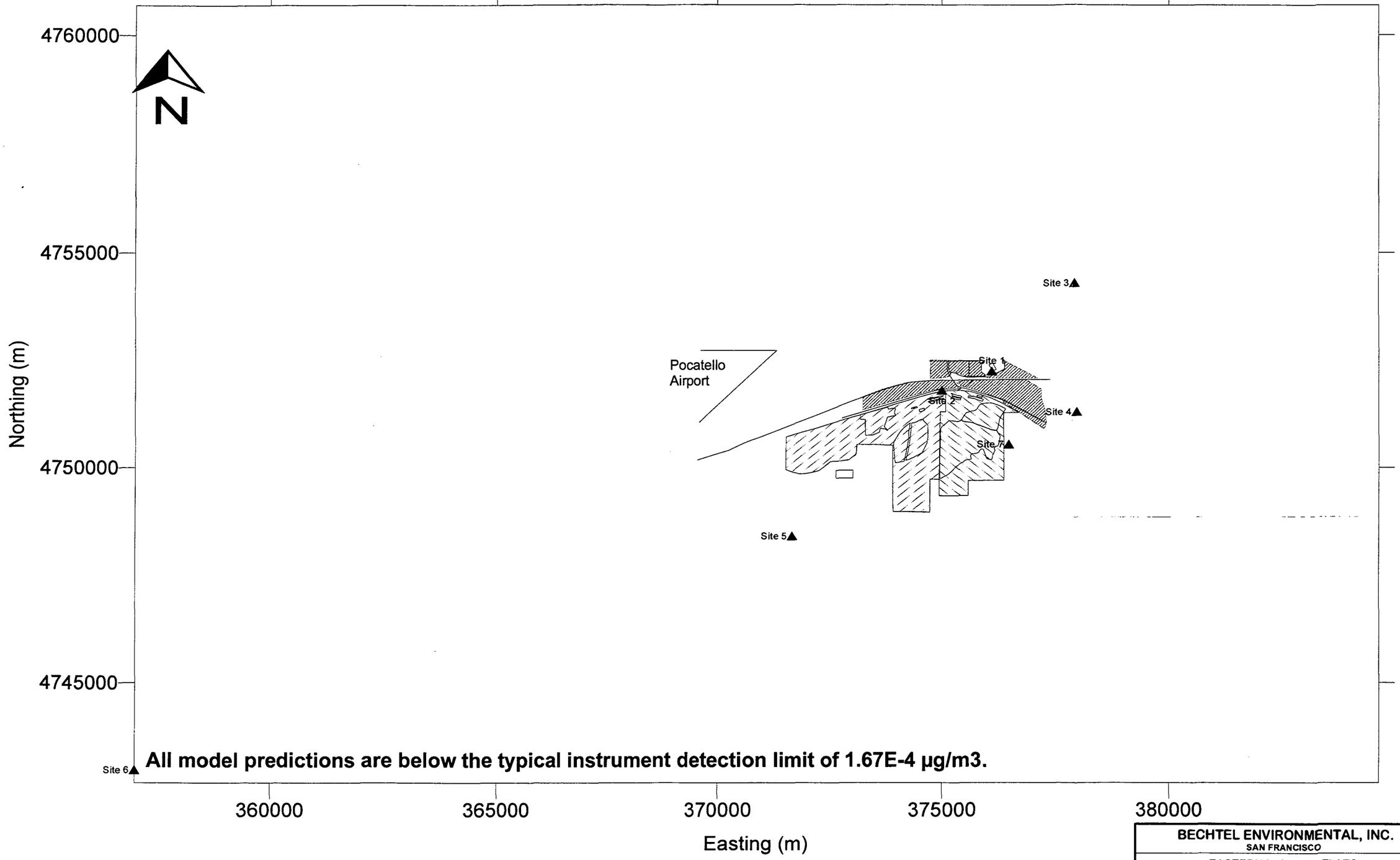
EPA Screening Level = 5.7E-4 µg/m3
Background Level = 5.1E-4 µg/m3
Highest Modeled Average Annual (without background) = 1.8E-3 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Arsenic Concentrations (µg/m3)

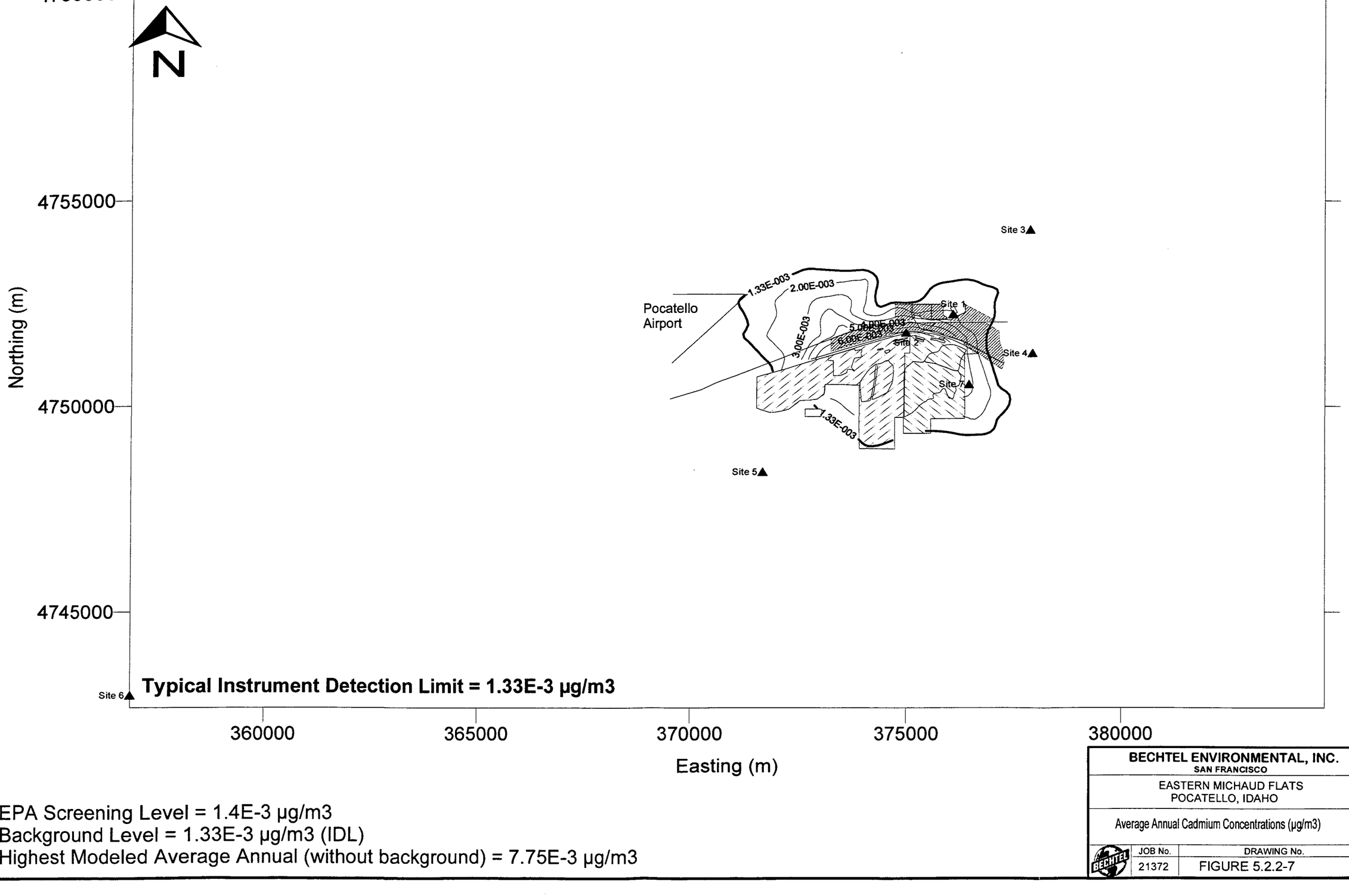
JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-5	O



All model predictions are below the typical instrument detection limit of 1.67E-4 µg/m3.

EPA Screening Level = 1.0E-3 µg/m3
Background Level = 1.67E-4 µg/m3 (IDL)
Highest Modeled Average Annual (without background) = 1.1E-5 µg/m3

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Average Annual Beryllium Concentrations (µg/m3)		
JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-6	O



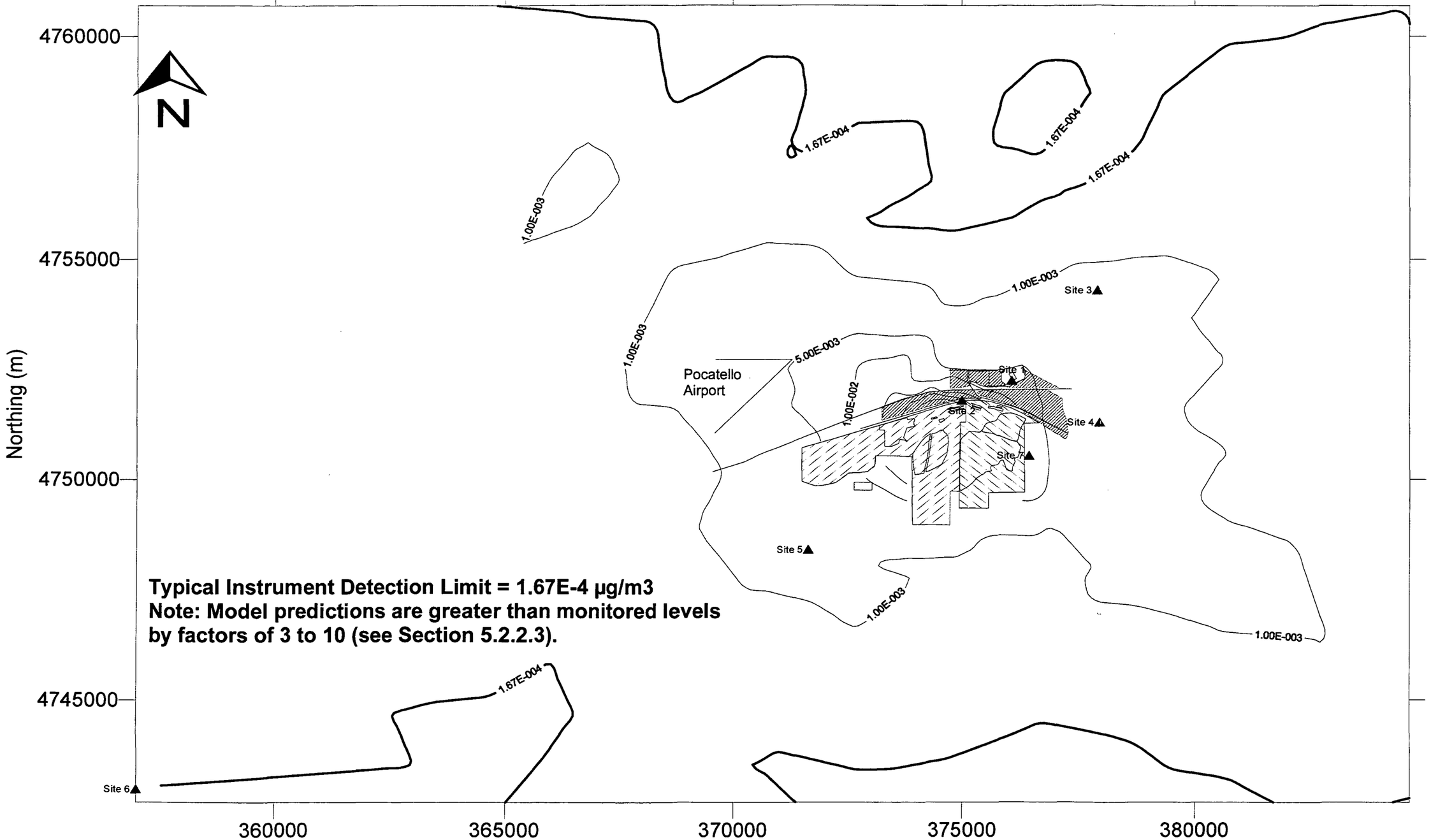
EPA Screening Level = 1.4E-3 µg/m3
Background Level = 1.33E-3 µg/m3 (IDL)
Highest Modeled Average Annual (without background) = 7.75E-3 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Cadmium Concentrations (µg/m3)

JOB No.	DRAWING No.	REV
21372	FIGURE 5.2.2-7	O



Typical Instrument Detection Limit = 1.67E-4 µg/m3
Note: Model predictions are greater than monitored levels by factors of 3 to 10 (see Section 5.2.2.3).

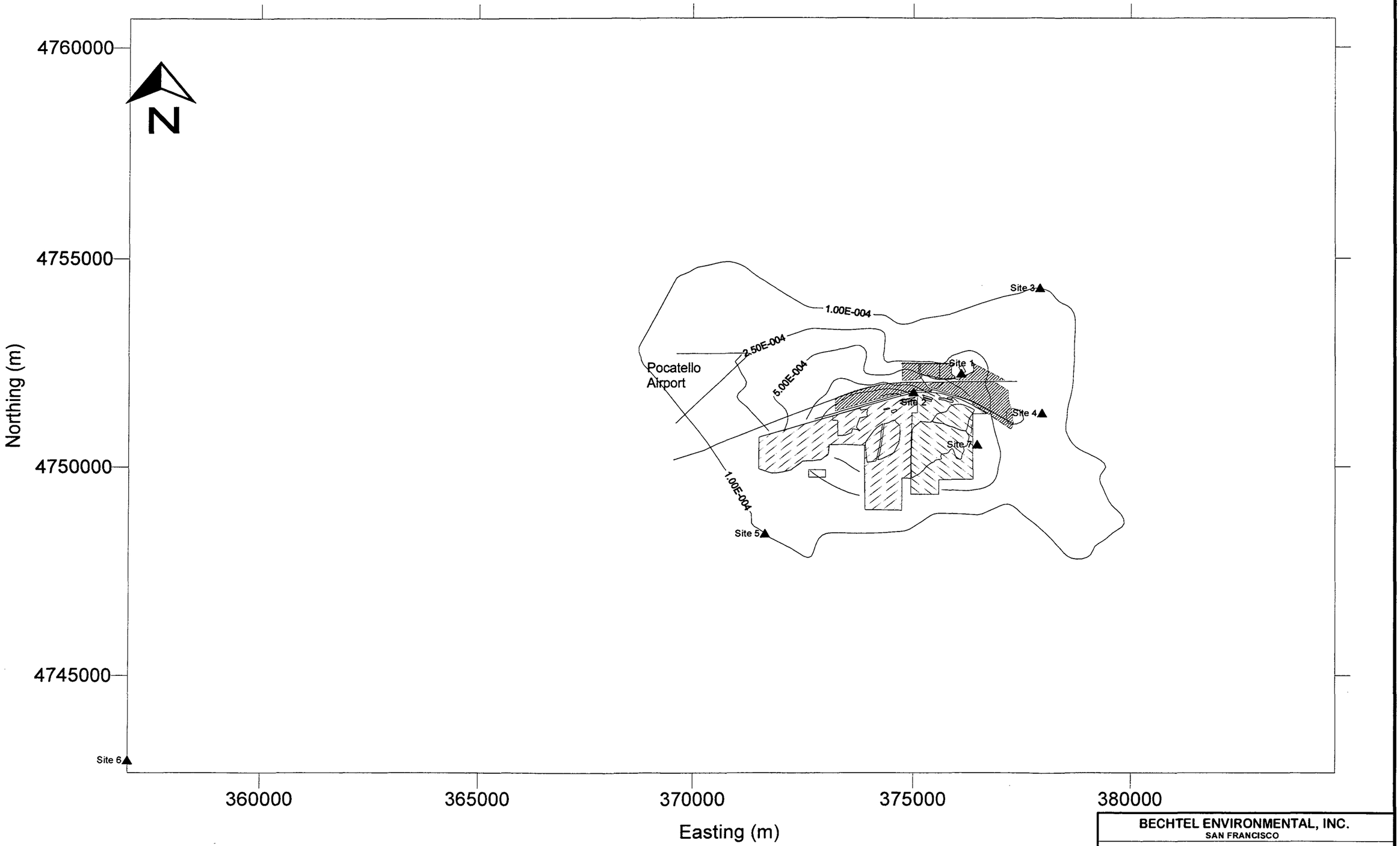
EPA Screening Level - not applicable
Background Level (Total Chromium) = 2.0E-4 µg/m3
Highest Modeled Average Annual (Total Chromium, without background) = 5.75E-2 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Total Chromium Concentrations (µg/m3)

JOB No.	DRAWING No.	REV
21372	FIGURE 5.2.2-8	O



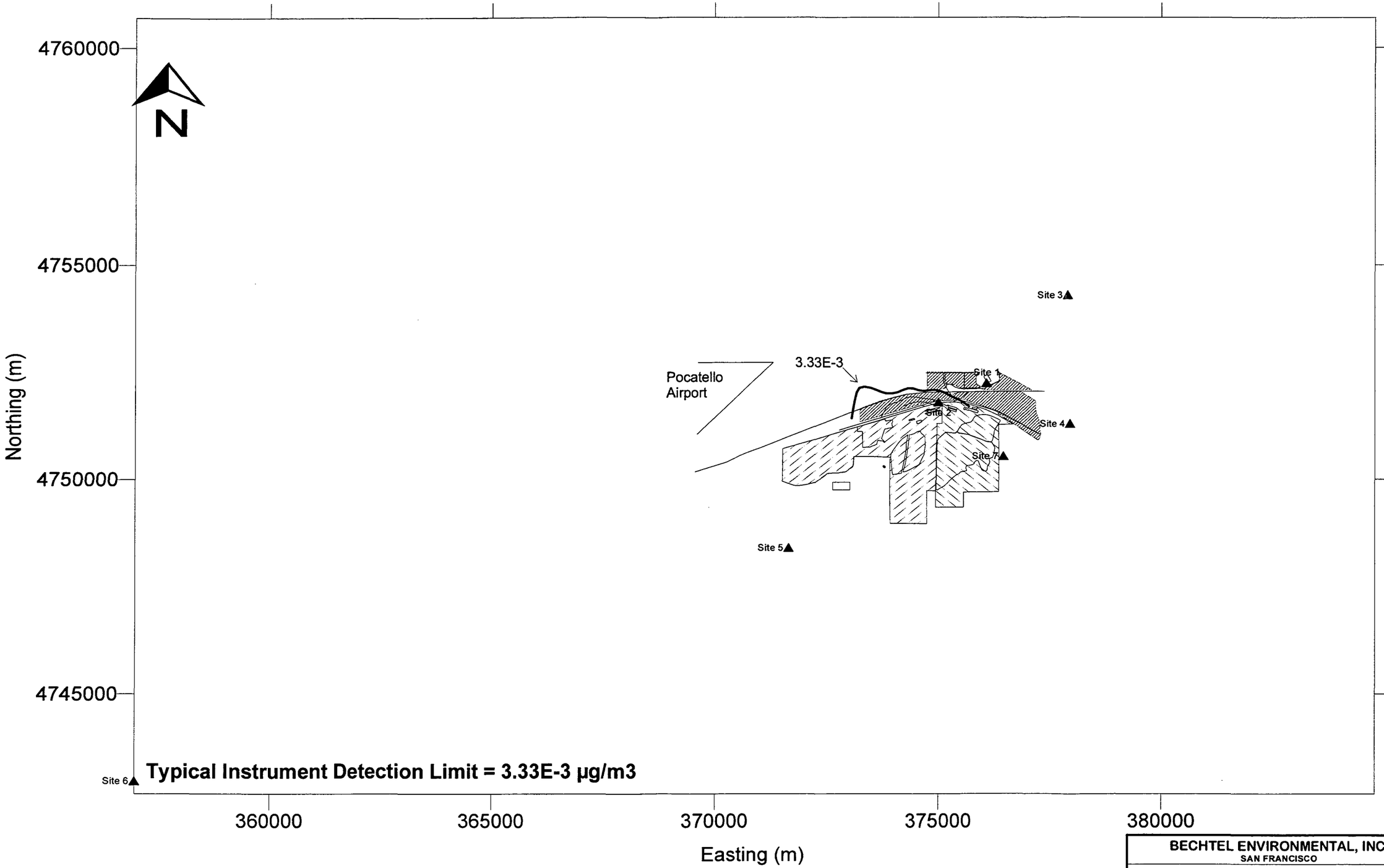
EPA Screening Level = 1.5 µg/m3
Background Level Not Monitored
Highest Modeled Average Annual = 2.3E-3 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Lead Concentrations (µg/m3)

JOB No.	DRAWING No.	REV
21372	FIGURE 5.2.2-9	O



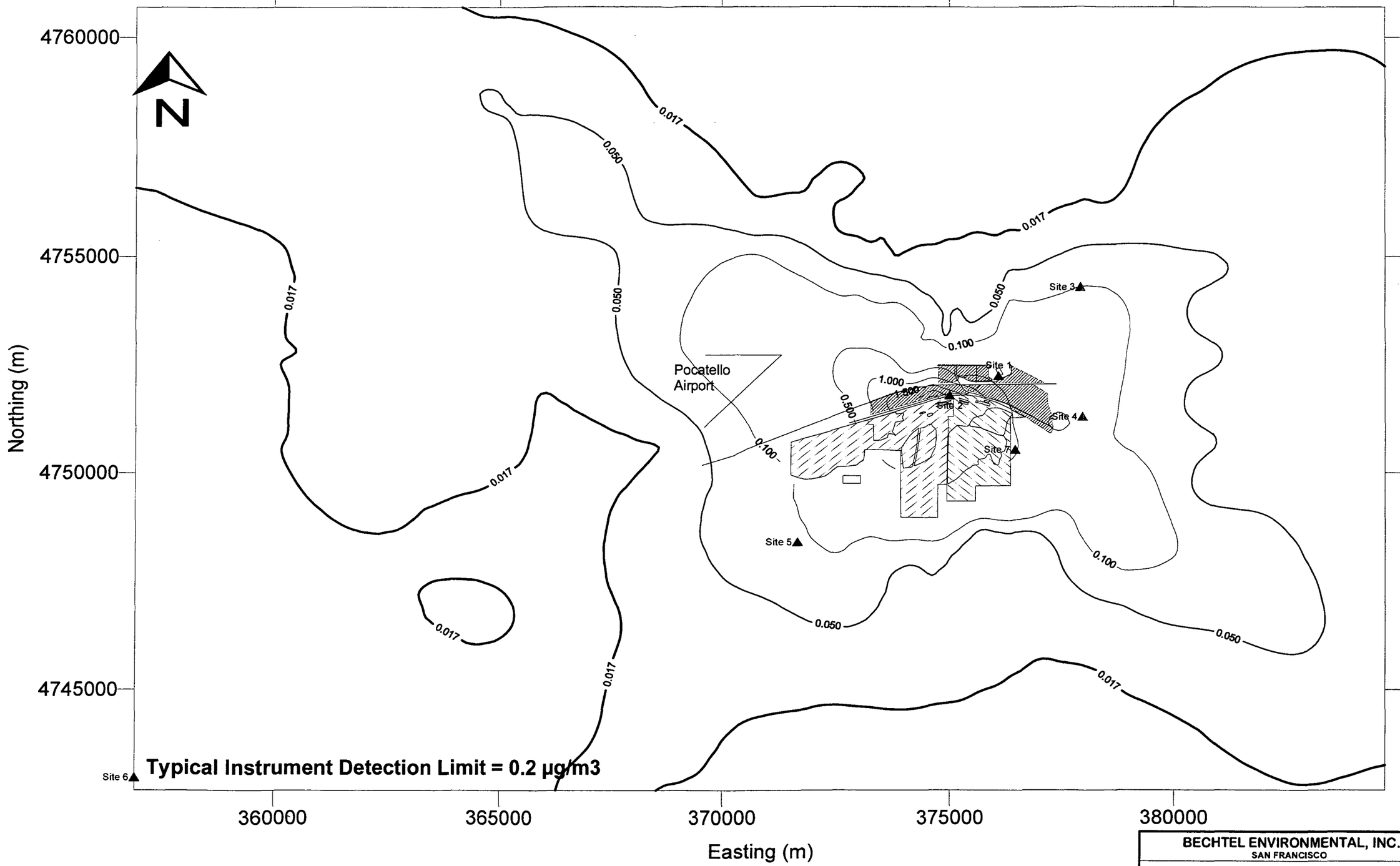
EPA Screening Level = 1.0E-2 µg/m3
Background Level = 3.33E-3 µg/m3 (IDL)
Highest Modeled Average Annual (without background) = 1.08E-2 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Nickel Concentrations (µg/m3)

JOB No.	DRAWING No.	REV
21372	FIGURE 5.2.2-10	O



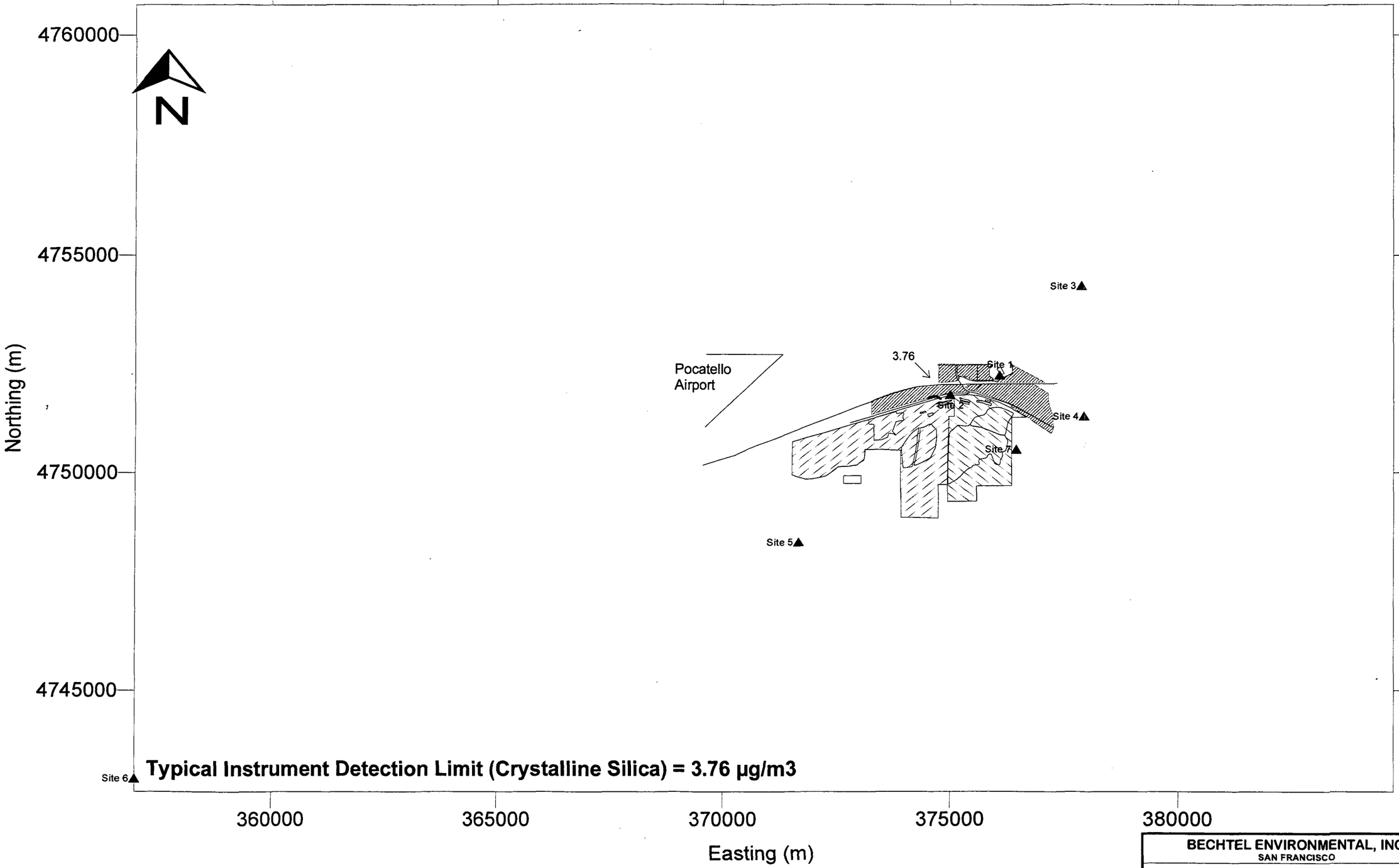
EPA Screening Level = 0.3 µg/m3
Background Level = 1.67E-3 µg/m3 (IDL)
Highest Modeled Average Annual (without background) = 3.0 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Total Phosphorus Concentrations (µg/m3)

JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-11	O



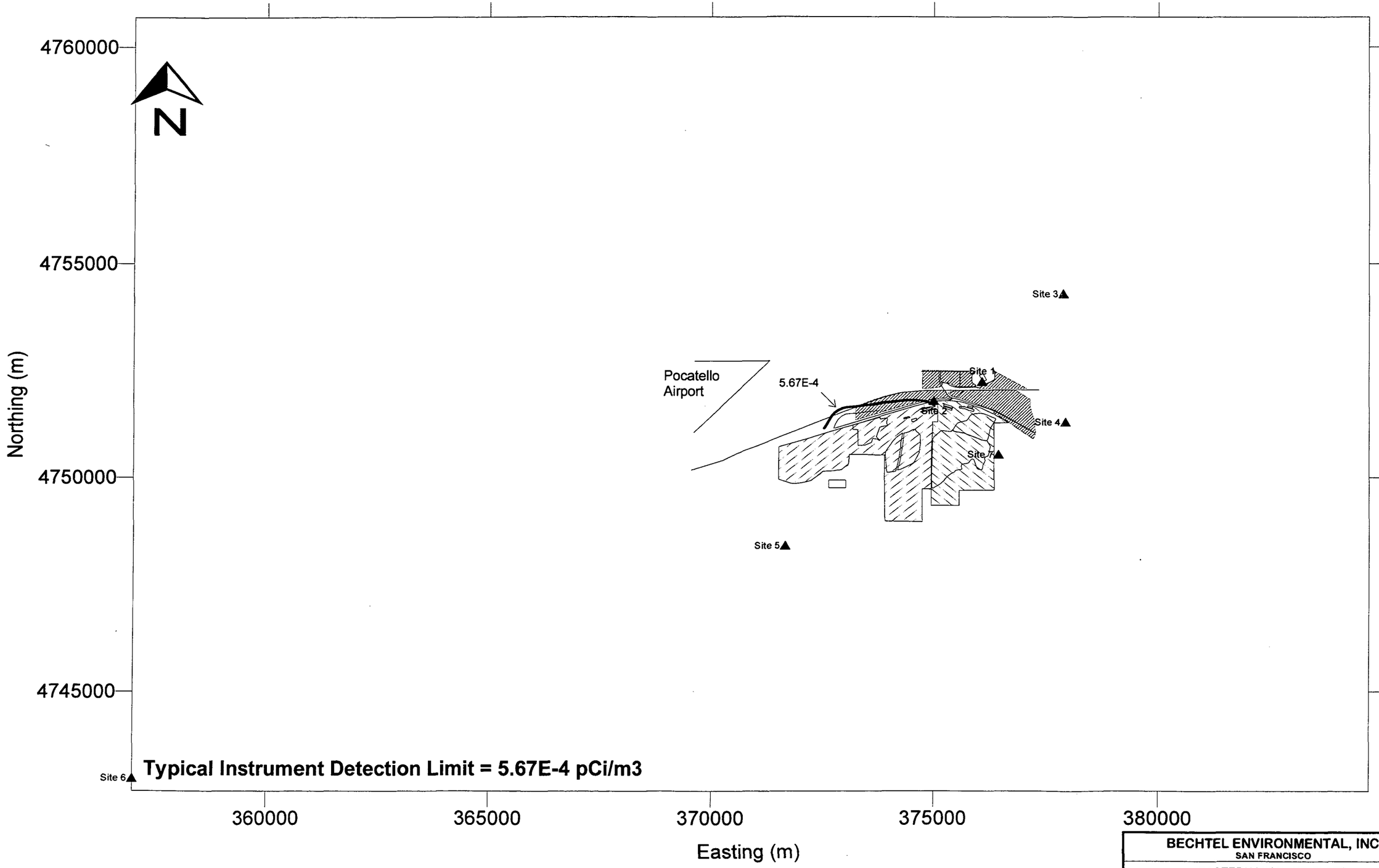
EPA Screening Level - not provided
Background Level = 26 µg/m3 (Crystalline Silica)
Highest Modeled Average Annual (Total Silica, without background) = 4.49 µg/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Total Silica Concentrations (µg/m3)

JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-12	O



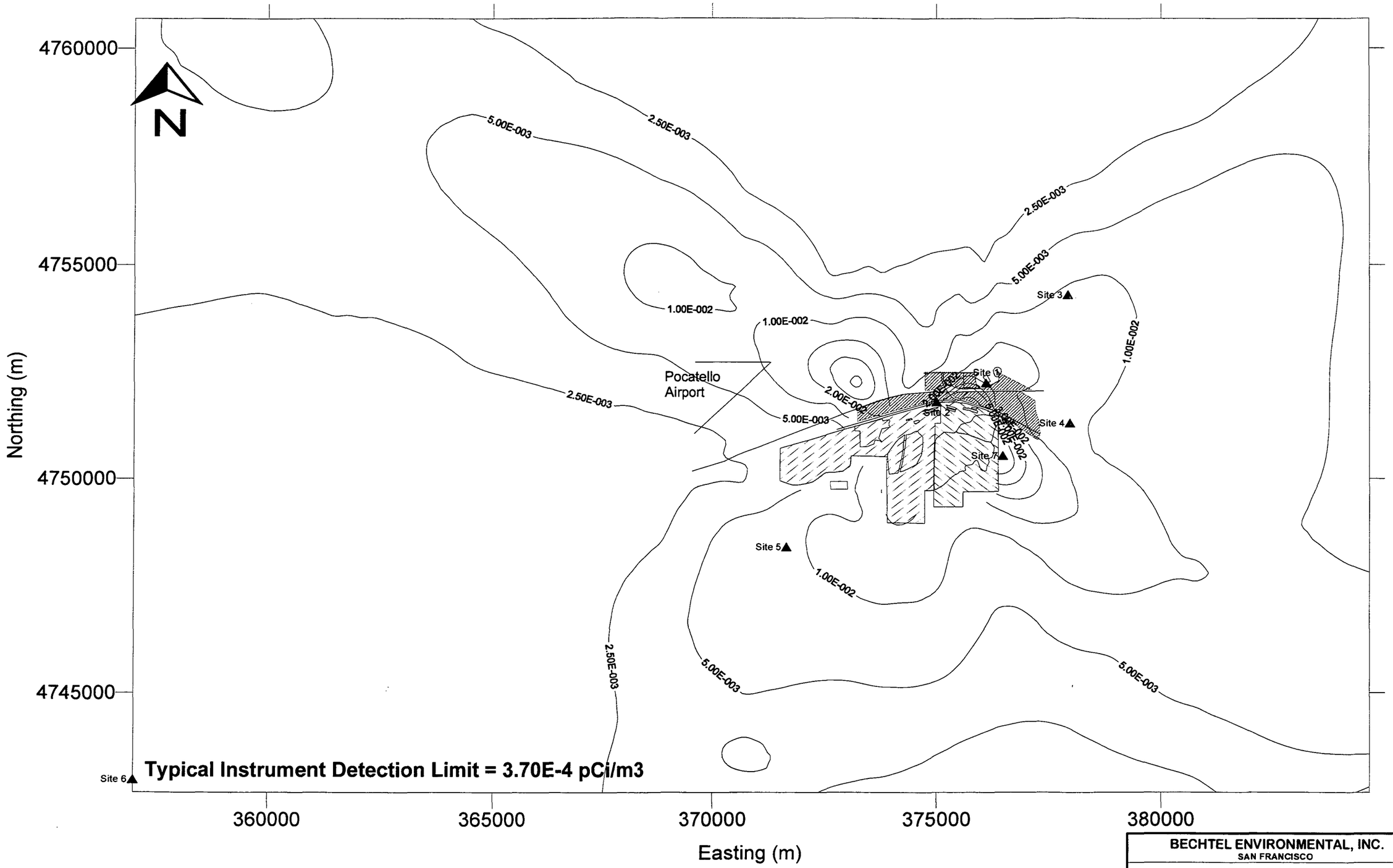
EPA Screening Level = 1.2E-3 pCi/m3
Background Level = 1.7E-2 pCi/m3
Highest Modeled Average Annual (without background) = 1.23E-3 pCi/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Lead-210 Activities (pCi/m3)

JOB No.	DRAWING No.	REV
21372	FIGURE 5.2.2-13	O



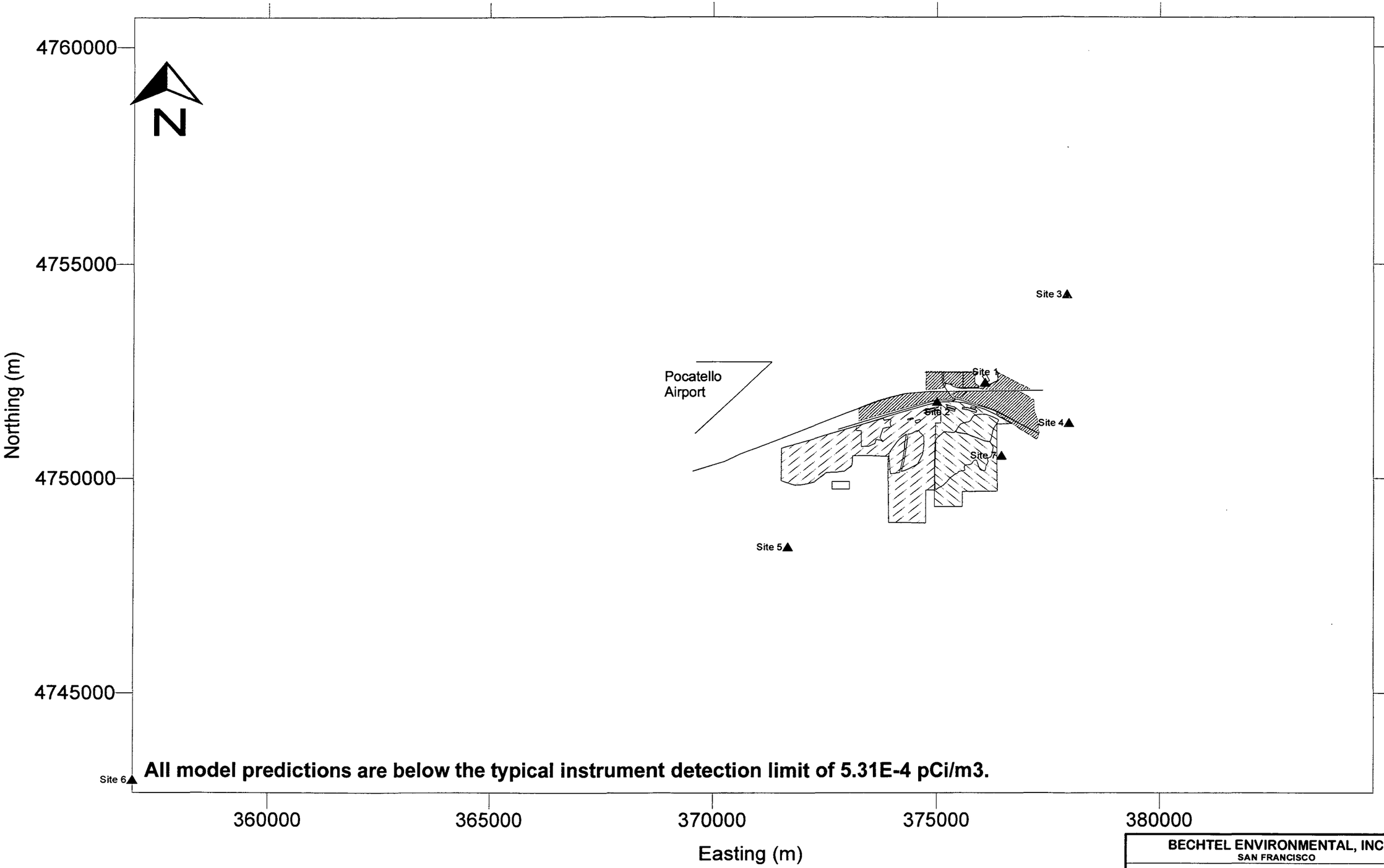
EPA Screening Level = 1.8E-3 pCi/m3
Background Level = 4.4E-3 pCi/m3
Highest Modeled Average Annual (without background) = 1.05E-1 pCi/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Polonium-210 Activities (pCi/m3)

JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-14	O



All model predictions are below the typical instrument detection limit of 5.31E-4 pCi/m3.

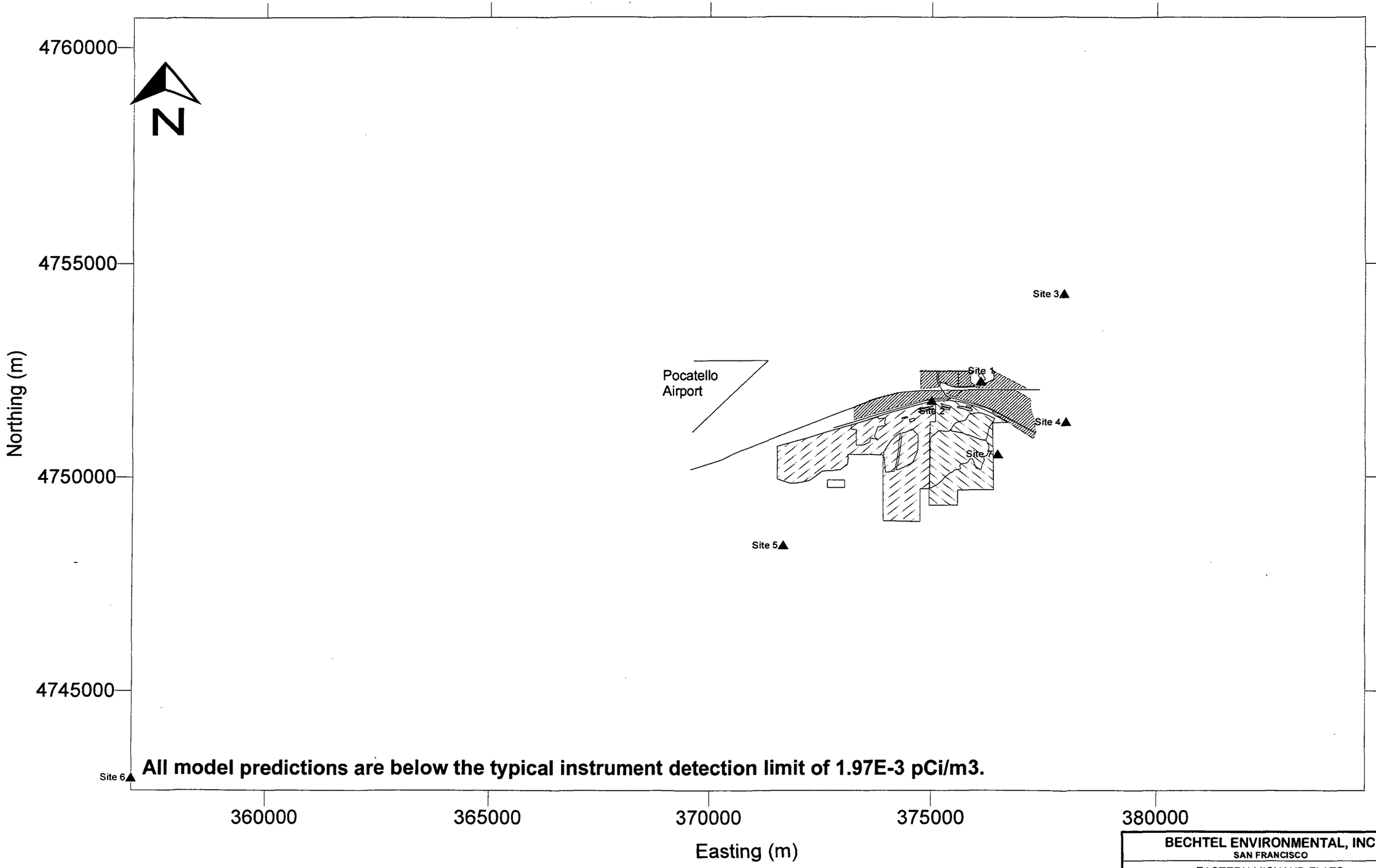
EPA Screening Level = 1.6E-3 pCi/m3
Background Level = 5.31E-4 pCi/m3 (IDL)
Highest Modeled Average Annual (without background) = 4.63E-4 pCi/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Radium-226 Activities (pCi/m3)

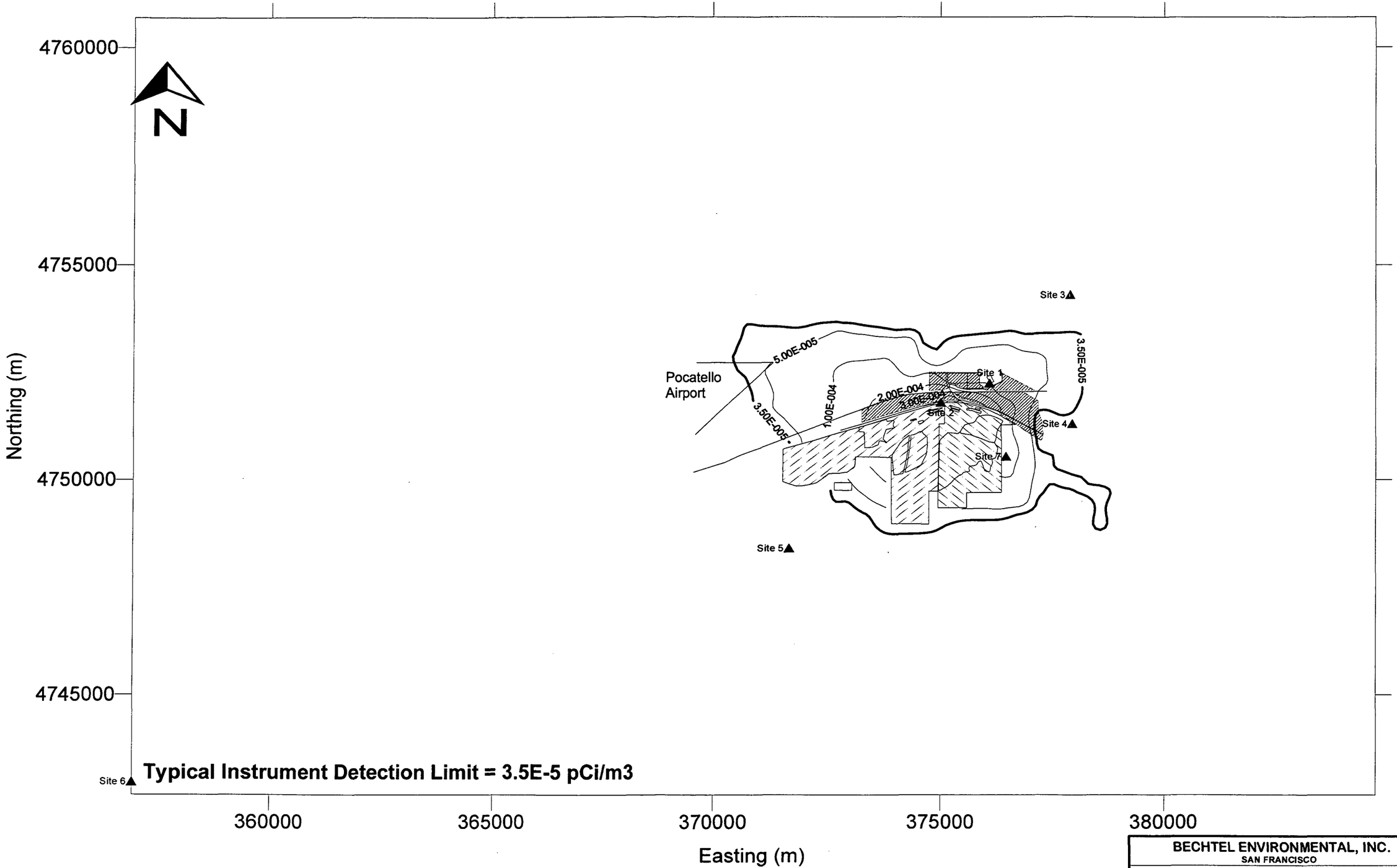
JOB No.	DRAWING No.	REV
21372	FIGURE 5.2.2-15	O



All model predictions are below the typical instrument detection limit of 1.97E-3 pCi/m3.

EPA Screening Level = 6.9E-3 pCi/m3
Background Level = 1.97E-3 pCi/m3 (IDL)
Highest Modeled Average Annual (without background) = 4.73E-5 pCi/m3

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Average Annual Radium-228 Activities (pCi/m3)		
JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-16	O



Typical Instrument Detection Limit = 3.5E-5 pCi/m3

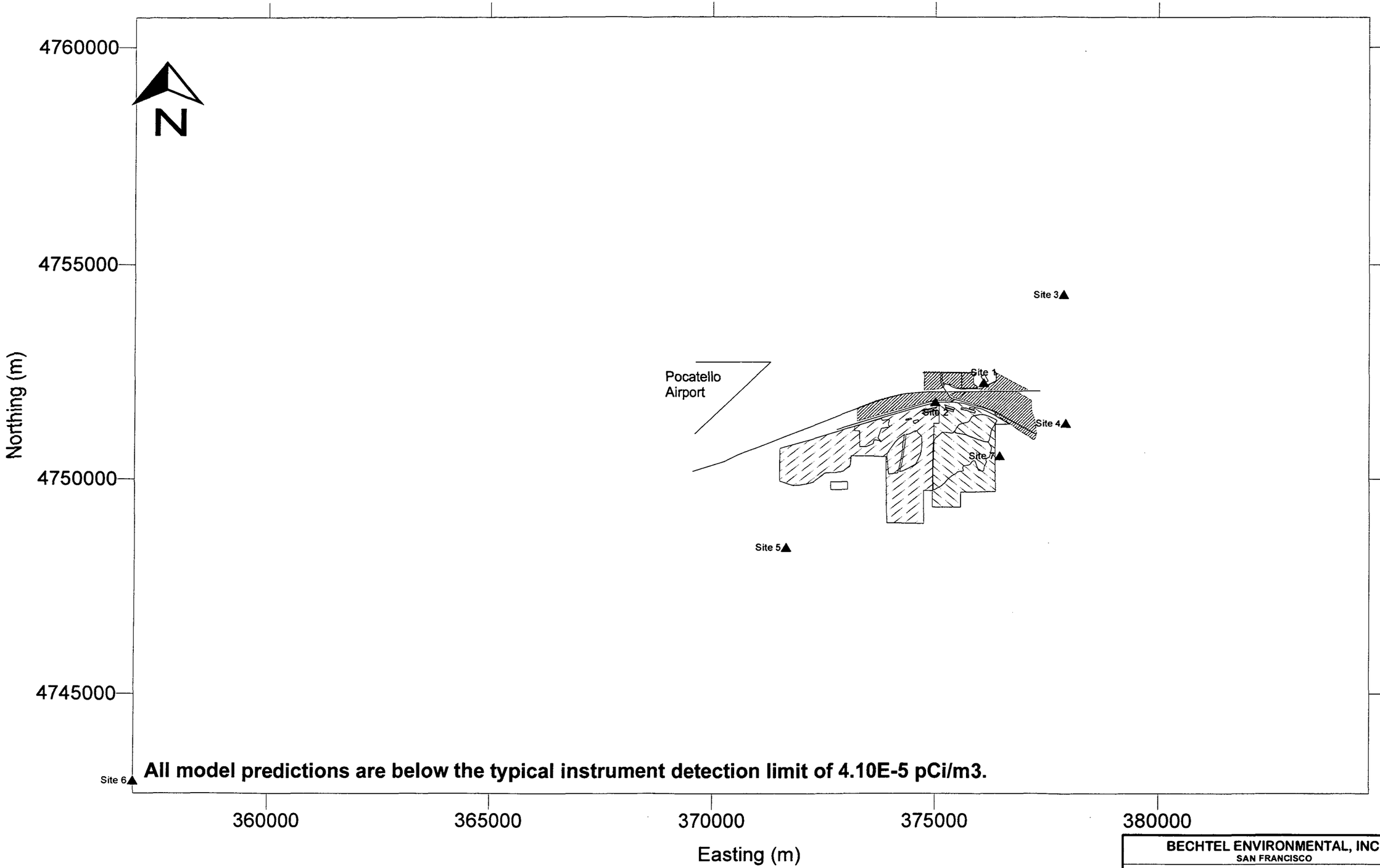
EPA Screening Level = 2.0E-4 pCi/m3
Background Level = 3.5E-5 pCi/m3 (IDL)
Highest Modeled Average Annual (without background) = 6.5E-4 pCi/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

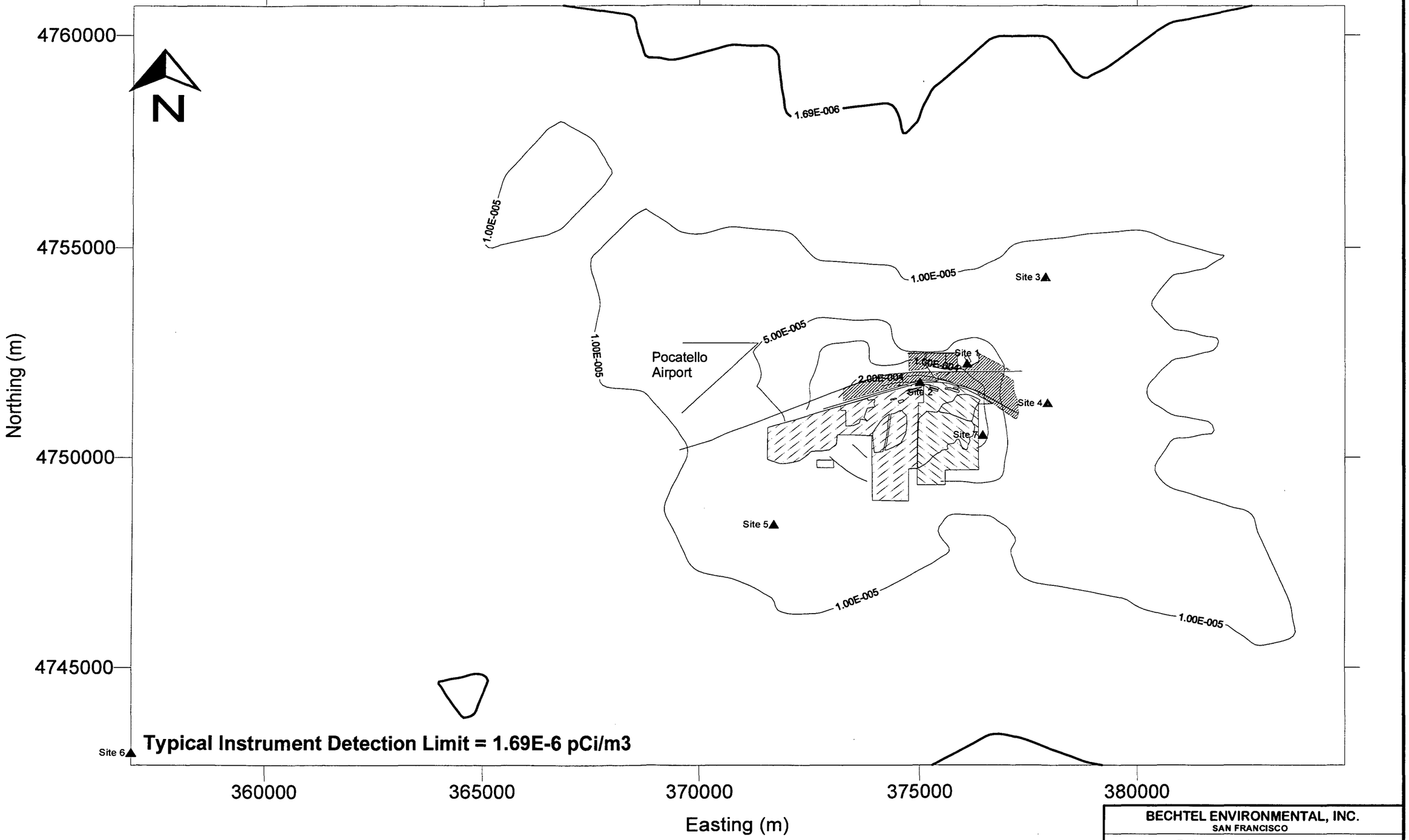
Average Annual Thorium-230 Activities (pCi/m3)

JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-17	O



EPA Screening Level = 2.0E-4 pCi/m3
Background Level = 4.01E-5 pCi/m3
Highest Modeled Average Annual (without background) = 4.73E-5 pCi/m3

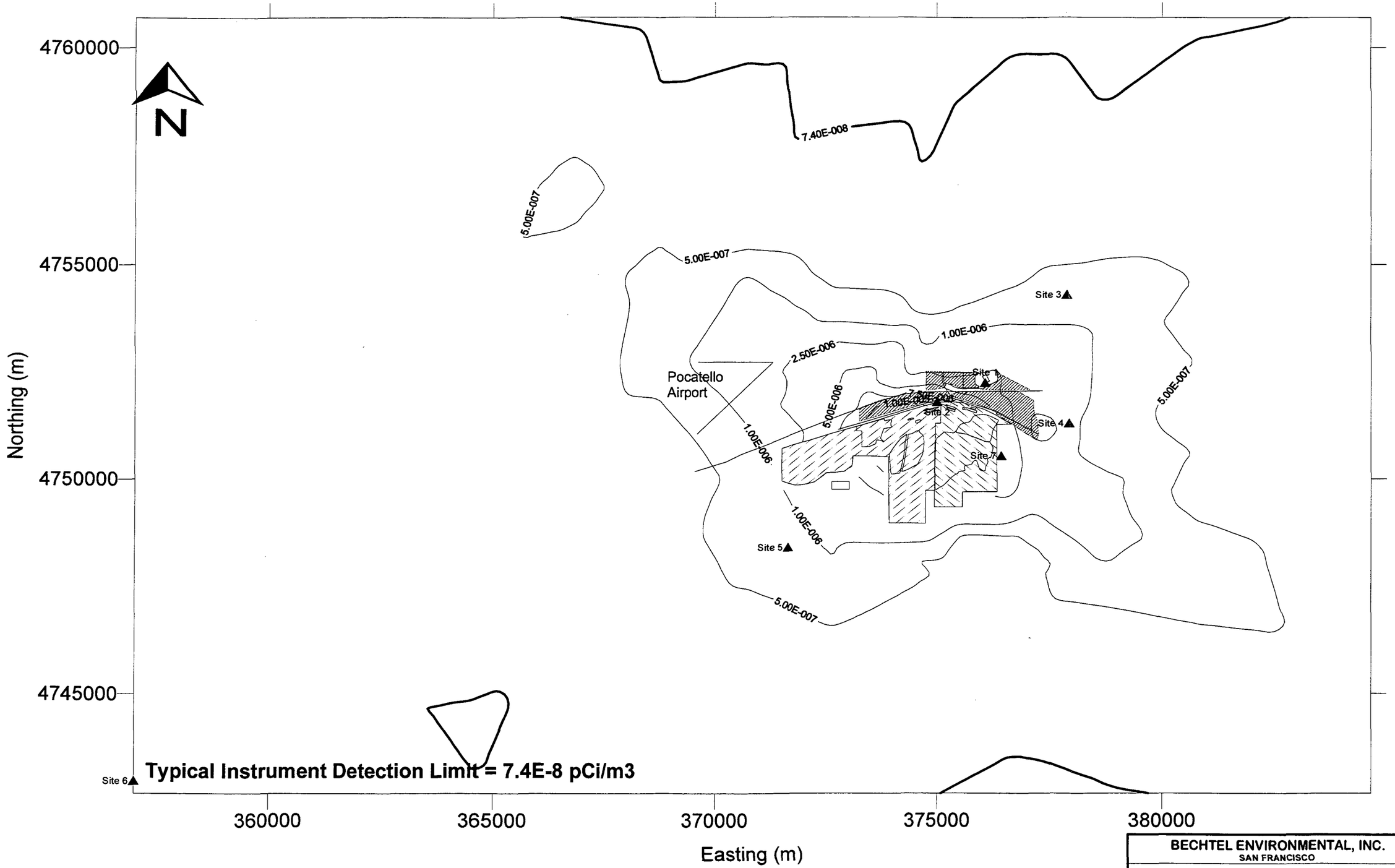
BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Average Annual Thorium-232 Activities (pCi/m3)		
JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-18	O



Typical Instrument Detection Limit = 1.69E-6 pCi/m3

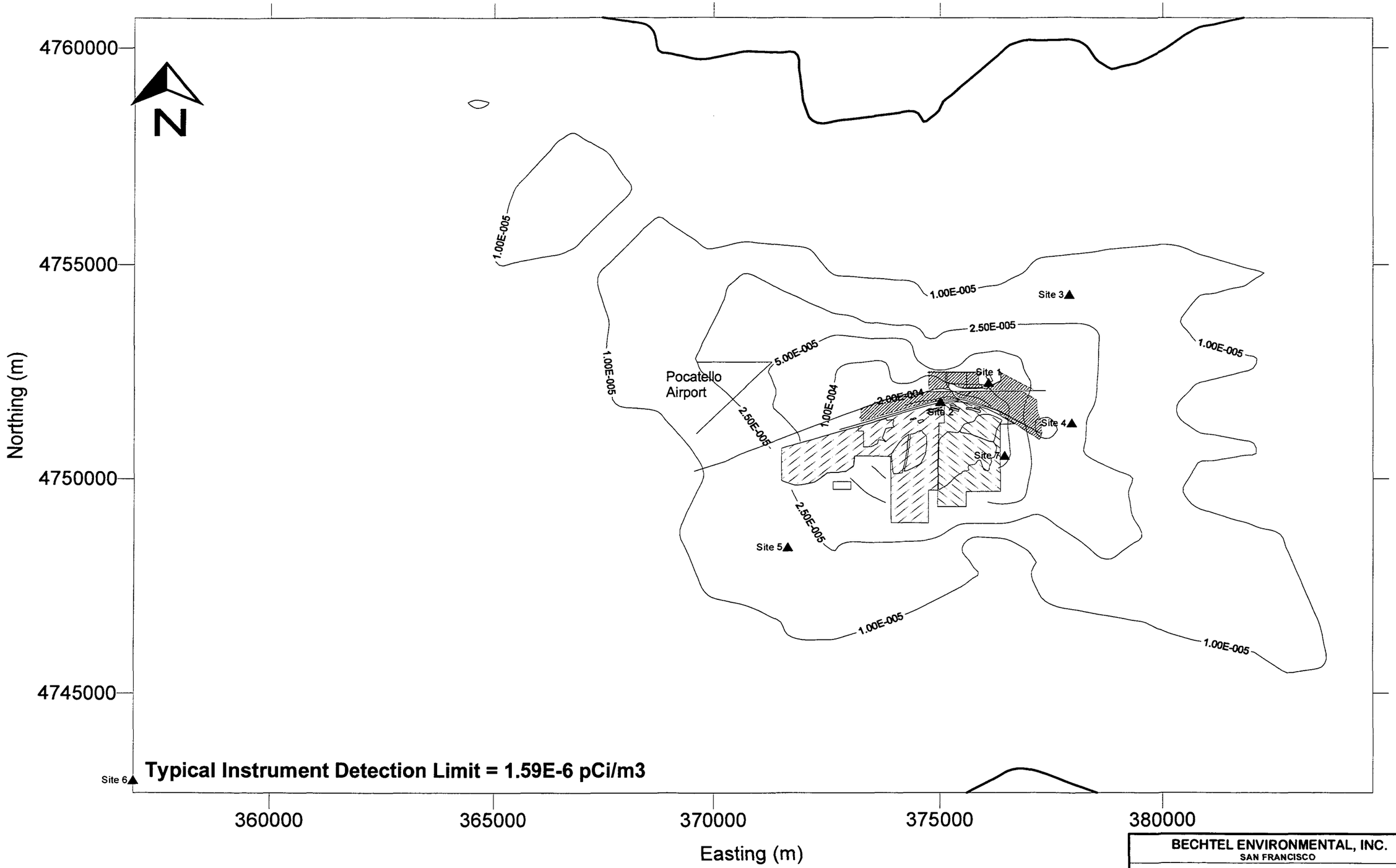
EPA Screening Level = 2.0E-4 pCi/m3
Background Level = 9.3E-6 pCi/m3
Highest Modeled Average Annual (without background) = 3.78E-4 pCi/m3

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
EASTERN MICHAUD FLATS POCATELLO, IDAHO		
Average Annual Uranium-234 Activities (pCi/m3)		
JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-19	O



EPA Screening Level = 2.0E-4 pCi/m3
Background Level = 4.1E-7 pCi/m3
Highest Modeled Average Annual (without background) = 1.61E-5 pCi/m3

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
EASTERN MICHAUD FLATS POCATELLO, IDAHO			
Average Annual Uranium-235 Activities (pCi/m3)			
	JOB No.	DRAWING No.	REV.
	21372	FIGURE 5.2.2-20	O



Typical Instrument Detection Limit = 1.59E-6 pCi/m3

EPA Screening Level = 1.0E-4 pCi/m3
Background Level = 8.7E-6 pCi/m3
Highest Modeled Average Annual (without background) = 4.70E-4 pCi/m3

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

Average Annual Uranium-238 Activities (pCi/m3)

JOB No.	DRAWING No.	REV.
21372	FIGURE 5.2.2-21	O

5.3 COMPARISONS OF DAILY MODEL PREDICTIONS WITH DAILY MONITORING RESULTS

This section presents a comparison of predicted daily constituent concentrations (or activities) with the daily constituent levels observed during the monitoring program. The combined II2 and FDM daily modeling predictions were made using the typical daily emission inventories for the FMC, Simplot, and BAPCO facilities. The predictions were compared with monitoring data from the seven EMF monitoring sites in three ways to evaluate model performance.

- The mean of the predicted daily constituent levels for the group of days on which monitoring occurred was compared with the mean of the daily constituent levels observed at each monitoring station (i.e., paired over time and space);
- All predicted daily constituent levels at each monitoring station were compared with all daily observed constituent levels at the station (i.e., unpaired in time but paired in space). This was done in two ways: comparison of all predicted levels with all observed levels, and comparison of the highest 26 predicted levels with the highest 26 observed levels (per EPA guidelines);
- The predicted daily constituent levels at each monitoring station were compared with the daily constituent observed levels at each station for those days when Site 6 was predominantly upwind of the EMF facilities (i.e., paired in time and space).

Section 5.3.1 describes the statistical procedures used in making these comparisons. The results of these comparisons are presented in Sections 5.3.2 through 5.3.4, respectively.

A fourth type of comparison was also made. The emission inventories were adjusted, as appropriate, to reflect specific plant operations on five days (October 24, 1993, January 4, 1994, January 20, 1994, April 14, 1994, and June 6, 1994). Predicted daily constituent levels at each monitoring station were compared with observed levels, as well as with predictions made using the unmodified inventories (i.e., paired in time and space). This was done to evaluate how well

the emission inventories and modeling methods characterize the variability of operating conditions. Appendix AJ presents the results of these case studies.

Model performance for 15 out of 18 constituents was within criteria established by EPA for acceptable model performance. Good agreement was observed between monitoring data and model predictions. The modeling results also demonstrate that the placement of the ambient monitoring stations was well-suited to evaluate facility-related emissions.

Total chromium emissions were found to be overstated in the typical daily emission inventories; this constituent was overpredicted at most monitoring sites in each type of comparison. Cadmium and polonium-210 were slightly overpredicted at various monitoring sites, and their emissions may be slightly overstated in the typical daily emission inventories.

Cadmium, total chromium, total fluoride, and polonium-210 were consistently overpredicted (at factors between 2 and 9 times greater than observed levels) at Site 7, which is in elevated terrain (approximately 375 feet higher than the elevation of the industrial operations area of the facilities). Analysis of the model and emission inventories (Section 5.4) indicated that the overpredictions are associated with constituents emitted predominantly from stacks. It also indicated that the overpredictions result from well-known technical limitations of atmospheric dispersion models to perform in elevated terrain and not from a significant overstatement in the constituents' emission rates.

5.3.1 METHODOLOGY

To evaluate model performance, a statistical analysis was performed using methods described in an EPA protocol (Cox, 1988) and a computer program, WVSCORE, developed by the author of the WYNDvalley model to implement the EPA protocol (Harrison, 1989). In these comparisons, invalid or missing observations from the monitoring data were eliminated from the study. The observed data set covered a nominal period of twelve months (October 1993 through September 1994) with observations every other day for gravimetric data, and a six month period (October

1993 through March 1994) with observations once every fourth day for all other constituents except total fluorides. Monitoring data for total fluorides were collected over seven months (October 1993 through April 1994).

For the WVSCORE analysis, the EPA protocol recommends that the highest 26 observed (if available; if less than 26 values are to be compared, no less than 4 values should be evaluated) and model-predicted values be compared statistically by methods described in the protocol (Cox, 1988).

The EPA protocol also suggests several means by which modeling and monitoring data can be evaluated. These include the choice of model and monitored data couples (or pairs). Unpaired data are those which may or may not be related in time and space. Paired data are those which are related in time and space. Pairing (or unpairing) in time indicates that both the predicted and observed data occur (or do not occur) at the same time. Pairing (or unpairing) in space indicates that both the predicted and observed data occur (or do not occur) at the same geographic location.

For this analysis, data have been evaluated as paired in space due to the wide spatial distribution of the monitoring network. Pairing (or unpairing) of data in time was dependent on the type of comparison, as previously stated.

Data collected after June 24, 1994 at Site 3 were eliminated from the analysis because this monitoring station no longer met siting criteria after this date, due to nearby construction activity. EPA recognized this change in condition and approved discontinuation of sampling at Station 3.

5.3.2 COMPARISONS OF MEAN DAILY PREDICTED LEVELS WITH MEAN DAILY OBSERVED LEVELS

Mean daily constituent concentrations (or activities) predicted by the model on those days for which monitoring samples were collected are listed opposite the corresponding 24-hour duration

monitoring sample results in Appendix AI-1. Predicted particulate levels (PM_{10} and TSP) were compared with monitored levels for 197 days between October 1993 through September 1994. Metals and radionuclide predictions were compared with monitored levels for 51 days between October 1993 through March 1994, and for two case study days after March 1994. Total fluoride predictions were compared with monitored levels for 65 days between October 1993 through April 1994.

The data presented in Appendix AI-1 illustrate the wide daily variation between observed and modeled data. A summary of statistics and data presented on Tables AI-1 through AI-15 (which do not reflect consideration of background) is shown on Table 5.3.2-1. Average background levels were added to these data to compare model behavior with monitoring data. If the constituent was not detected in the background samples, no background value was added to the model-predicted value.

These data indicate that at almost all sites, after the addition of background, total chromium appears to be overstated in the typical daily emission inventory. No constituents appear to be consistently understated. At Site 5, total phosphorus appears to be understated in the emission inventory. However, thorium-230 was detected in only three samples (out of 47) at Site 5. Thus, the model prediction is generally comparable with observed levels. At Sites 3 and 4, uranium appears to be overstated in the emission inventory. This is also the case for total phosphorus at Site 5.

At Site 7, TSP, arsenic, cadmium, total chromium, total phosphorus, polonium-210, thorium-230, and uranium were all significantly overpredicted. (Section 5.4 discusses how these overpredictions may be caused by the inherent limitations of the modeling code to accurately predict constituent levels at receptors in elevated terrain.)

TABLE 5.3.2-1
MEAN DAILY MONITORED TO MEAN DAILY MODELED CONSTITUENT COMPARISONS

RECEPTOR	SITE	MEAN DAILY VALUE (WITHOUT BACKGROUND)[1, 2, 4, 5]			MEAN DAILY VALUE (WITH BACKGROUND)		
		Underpredict	Within a Factor of 2[3]	Overpredict	Underpredict	Within a Factor of 2[3]	Overpredict
Near Field	1	PM_{10}, TSP, F, Pb-210,	As, Be, Cd, Ni, P, Ra-226, Th-230, U-238	Cr, Po-210		PM_{10}, TSP, As, Be, Cd, F, Ni, P, Pb-210, Ra-226, Th-230, U-238	Cr, Po-210
	2	Pb-210	PM_{10}, TSP, As, Be, Cd, F, P, Po-210, Ra-226, U-238	Cr, Ni, Th-230		PM_{10}, TSP, As, Be, Cd, F, P, Pb-210, Po-210, Ra-226, U-238	Cr, Ni, Th-230
	7	F, Pb-210	PM_{10}, TSP, As, Be, Ni, Ra-226	Cd, Cr, P, Po-210, Th-230, U-238		PM_{10}, Be, F, Ni, Pb-210, Ra-226	TSP, As, Cd, Cr, P, Po-210, Th-230, U-238
Far Field	3	PM_{10}, TSP, As, $F^{(2)}$, Pb-210	Be, Cd, Ni, P, Po-210, Ra-226, Th-230	Cr, U-238		PM_{10}, TSP, As, Be, Cd, $F^{(2)}$, Ni, P, Pb-210, Po-210, Ra-226, Th-230	Cr, U-238
	4	PM_{10}, TSP, As, $F^{(2)}$, Pb-210	Be, Cd, Ni, Po-210, Ra-226, Th-230	Cr, P, U-238		PM_{10}, TSP, As, Be, Cd, $F^{(2)}$, Ni, Pb-210, Po-210, Ra-226, Th-230	Cr, P, U-238
	5	PM_{10}, TSP, As, $F^{(2)}$, P, Pb-210, Th-230	Be, Cd, Cr, Ni, Po-210, Ra-226, U-238		P	PM_{10}, TSP, As, Be, Cd, Cr, $F^{(2)}$, Ni, Pb-210, Po-210, Ra-226, Th-230, U-238	
Background	6	PM_{10}, TSP, As, F, P, Ra-226, Pb-210, Po-210, U-238	Be, Cd, Cr, Ni, Th-230			PM_{10}, TSP, As, Be, Cd, F, Ni, P, Pb-210, Po-210, Ra-226, Th-230, U-238	Cr

Notes:
[1] Sites with one data point or less are not indicated for means.
[2] Particulate fluorides (monitored) only were used for comparisons at sites 3, 4, and 5.
[3] Model prediction is within a factor of two of the mean of the observed level, or both model prediction and monitoring indicate that the constituent was below detection level.
[4] Total silica was not compared with measured crystalline silica.
[5] U-238 is assumed to be typical of U-234 and U-235 behavior.

5.3.3 COMPARISON OF DAILY PREDICTED WITH DAILY OBSERVED CONSTITUENT LEVELS

To further evaluate data listed in Appendix AI-1, scatter plots of predicted and observed levels were developed for each monitoring site and constituent. These data were compared on an unpaired (in time) basis following EPA protocol suggestions (Cox, 1988). The choice of using unpaired data was made after an initial review of the data showed little understanding could be gained using paired data. However, paired (in time) data have been evaluated using a subset of these data based on upwind:downwind relationships (Section 5.3.4).

These scatter plots are provided in Appendix AI-2 (Figures AI-2-1 through AI-2-91). Included on these plots are dashed lines showing the bounds of the factor of 2 domain. Also included is an additional plot of model predicted data to which background was added (noted as "M+B" on the figures). The background level was calculated as the arithmetic average of 24-hour concentrations (or activities) measured at Site 6 for the days when Site 6 was upwind of the EMF facilities. If a constituent was not detected in these upwind samples, no addition of background was made. An example of an unpaired scatter plot is shown on Figure 5.3.3-1. A summary of these comparisons is provided on Table 5.3.3-1.

At all sites, after the addition of background levels, total chromium appears overstated in the daily emission inventory. These patterns are similar to those found when comparing the mean daily levels of total chromium (Table 5.3.2-1). No constituents appear to be consistently understated once background levels were added. At Sites 3 and 5, total phosphorus was underpredicted, and thorium-230 was underpredicted at Site 5. At Site 4, the overprediction of total phosphorus is based on a comparison of very few data points (2 out of 50 observations occur above the IDL); therefore this conclusion may not be meaningful (Figure AI-2-53).

TABLE 5.3.3-1
MONITORED TO MODELED DAILY CONSTITUENT COMPARISONS (UNPAIRED DATA)

RECEPTOR	SITE	DAILY VALUE (WITH BACKGROUND)[1, 3]		
		Underpredict	**Within a Factor of 2[2]**	**Overpredict**
Near Field	1	F	PM_{10}, TSP, As, Be, Cd, Ni, P, Pb-210, Ra-226, Th-230, U-238	Cr, Po-210
	2		PM_{10}, TSP, As, Be, Cd, F, P, Pb-210, Po-210, Ra-226, Th-230, U-238	Cr, Ni
	7		PM_{10}, TSP, As, Be, F, Pb-210, Ra-226	Cd, Cr, Ni, P, Po-210, Th-230, U-238
Far Field	3	P	PM_{10}, TSP, As, Be, Cd, Ni, Pb-210, Po-210, Ra-226, Th-230, U-238	Cr
	4		PM_{10}, TSP, As, Be, Cd, Ni, Pb-210, Po-210, Ra-226, Th-230, U-238	Cr, P
	5	P, Th-230	PM_{10}, TSP, As, Be, Cd, Ni, Pb-210, Po-210Ra-226, U-238	Cr

Notes: [1] Sites with one data point or less are not indicated.
[2] Model prediction is within a factor of two of observed level, or both model prediction and monitoring indicate that constituent was below the detection level.
[3] U-238 is assumed to be typical of all uranium isotopes.

At Site 7, cadmium, total chromium, nickel, total phosphorus, polonium-210, thorium-230, and uranium were all significantly overpredicted. This was similar to the pattern found for the daily means of these same constituents at Site 7 (Table 5.3.2-1). A similar but substantially smaller degree of overprediction was observed for polonium-210 at Site 1. Total fluoride was slightly underpredicted at Site 1 and then only at the upper range of monitored concentrations.

Comparison of Highest 26 Predicted and Observed Levels

The daily predicted and observed constituent levels described above were compared in an additional manner to gain further insight into model performance. Provided in Appendix AI-3 are sets of output produced by WVSCORE for several key constituents. WVSCORE computes several comparisons between model predictions and monitored observations, and estimates the probability that repeated comparisons with new data (that display the same probability distributions) will display scores within stated bounds. WVSCORE calculates the following:

(1) The means of the predictions and of the observations;
$\langle X \rangle = (1/N)$ sum from i=1 to N of X_i

(2) The standard deviations: S.D. = $[\langle X^2 \rangle - \langle X \rangle^2]^{1/2}$;

(3) A Robust-Highest-Concentration estimator, RHC,

(4) The fraction of predictions that agree with observations within a factor of two;

(5) The slope [B] of the regression equation:

[Predictions] = zero + B * [Observations] computed as the geometric mean of the two slopes that would be derived under the separate assumptions that all of the errors were in the predictions, or in the observations. [Note: This regression is forced through the origin.];

(6) Pearson's correlation coefficient between the predictions and observations;

(7) The Coefficient of Determination, R^2, [sometimes called the 'Multiple Correlation Coefficient'].

(8) The root-mean-square (rms) relative error, MRE = $\text{sqr}[\langle 2\{(P_r-O_b)/(P_r+O_b)\}^2 \rangle]$.

(9) An MRE weighted by $[P_r+O_b]^2$, for which $\text{wMRE} = 2 * (\langle [P_r-O_b]^2 \rangle)^{1/2} / (\langle [P_r+O_b]^2 \rangle)^{1/2}$. This score is appropriate when one wishes to emphasize the effect of the higher-concentration episodes.

(10) A robustly weighted MRE, where 5%, each, of the most positive and most negative $(P_r-O_b)/(P_r+O_b)$ are pruned from the sample before squaring and averaging. This score is appropriate "when unphysical results from wild data are suspected" (Harrison, 1989).

The first three calculated results of these comparisons are appropriate when the observations and predictions are not paired in time and space; the last seven, conversely. In this analysis, the first three calculated values listed above are appropriate for use, since data input to WVSCORE consists of unpaired model predictions to which a background value has been added. To interpret scores produced by these three equations, a value of $\pm$ 0.67 defines the region equivalent to the factor-of-2 domain (i.e., when values less than $\pm$ 0.67 are within the factor-of-2 domain and the results are judged to be acceptable).

WVSCORE results are presented in Appendix AI-3 for PM_{10}, arsenic, cadmium, chromium, polonium-210, uranium-238, and total fluorides, and where appropriate, include background values. These constituents are representative of typical emissions from ground-based and elevated stack sources within the inventory. While the WVSCORE results are of numerical interest to some, it is felt that the scatter plots found in Appendix AI-2 provide an opportunity to evaluate the model performance by direct visual means. Additionally, WVSCORE analyzes only the upper end of observed and predicted data (due to the limit of input data to the top 26 data points) while the scatter plots show model performance over the entire range of model prediction, both low and high. In essence, the scatter plots provide the same information as the numerical scores produced by WVSCORE. The comparisons obtained using the WVSCORE calculations are summarized in Table 5.3.3-2.

TABLE 5.3.3-2
COMPARISON OF HIGHEST 26 DAILY MONITORED WITH HIGHEST 26 DAILY MODELED CONSTITUENT LEVELS

RECEPTOR	SITE	DAILY VALUE (WITH BACKGROUND)[1]		
		Underpredict	Within a Factor of 2[2]	Overpredict
Near Field	1	F	PM_{10}, As, U-238	Cd, Cr, Po-210
	2	F	PM_{10}, As, Cd, Po-210, U-238	Cr
	7		PM_{10}, F	As, Cd, Cr, Po-210, U-238
Far Field	3	PM_{10}, As		Cd, Cr, Po-210, U-238
	4	PM_{10}, As	Cd	Cr, Po-210, U-238
	5	As	PM_{10}, Cd, Cr, Po-210, U-238	

Notes: [1] Sites with one data point or less are not indicated.
[2] Model prediction is within a factor of two of observed level, or both model prediction and monitoring indicate that constituent was below detection level.

At most sites, after the addition of background levels, high-end predictions of cadmium, total chromium, polonium-210, and uranium-238 appear overstated in the daily emission inventory. No constituents appear to be consistently understated.

At Sites 3 and 4 high end predictions of PM_{10} and arsenic appear understated in the emission inventory. At Site 7, arsenic, cadmium, total chromium, and polonium-210 were overpredicted; this is similar to the comparisons of the daily means and all daily results at Site 7, shown in Tables 5.3.2-1 and 5.3.3-1. Total fluoride was slightly underpredicted at Sites 1 and 2, and then only at the upper end of monitored data.

5.3.4 UPWIND VERSUS DOWNWIND COMPARISONS

The third type model performance analysis was a comparison of predicted concentrations (or activities) with observed levels for those days when Site 6 was upwind of the EMF facilities. These comparisons are paired in time and space. The methods used to identify these days is presented in Section 4 of Volume 1 of Part III of the RI Report. Site 6 was upwind over much, but not all, of the period of the monitoring program. Thus, an analysis of model performance on

days when background levels could be clearly defined should provide a clear insight into model performance on a paired basis.

As with the unpaired data analysis described in Section 5.3.3, scatter plots were developed for each monitoring site and constituent. These plots are provided in Appendix AI-2 (Figures AI-2-92 through AI-2-169). Included on these plots are dashed lines showing the bounds of the factor of 2 domain. Also included is an additional plot of model-predicted data to which the background concentration measured at Site 6 for that day was added (noted as "M+S6" on the figures). If the constituent was not detected at Site 6 on a given day, no background level was added to the prediction. These comparisons are summarized in Table 5.3.4-1.

TABLE 5.3.4-1
MONITORED TO MODELED CONSTITUENT COMPARISONS ON DAYS WHEN SITE 6 WAS ALWAYS UPWIND OF THE EMF FACILITIES

RECEPTOR	SITE	DAILY VALUE (WITH BACKGROUND)[1,3]		
		Underpredict	Within a Factor of 2[2]	Overpredict
Near Field	1	F	PM_{10}, TSP, As, Be, Ni, P, Pb-210, Ra-226, Th-230, U-238	Cd, Cr, Po-210
	2		PM_0, TSP, As, Be, Cd, F, P, Pb-210, Po-210, Ra-226, Th-230, U-238	Cr, Ni
	7		PM_0, TSP, As, Be, Ni, F, P, Pb-210, Ra-226, Th-230, U-238	Cd, Cr, Po-210
Far Field	3	P	PM_0, TSP, As, Be, Cd, Cr, Ni, Pb-210, Po-210, Ra-226, Th-230, U-238	
	4		PM_0, TSP, As, Be, Cd, Ni, P, Pb-210, Ra-226, Th-230, U-238	Cr, Po-210
	5		PM_0, TSP, As, Be, Cd, Cr, Ni, P, Pb-210, Po-210, Ra-226, Th-230, U-238	

Notes: [1] Sites with one data point or less are not indicated.
[2] Model prediction is within a factor of two of the observed level, or both model prediction and monitoring indicate that constituent was below the detection level.
[3] U-238 is assumed to be typical of all uranium isotopes.

After the addition of background, total chromium and polonium-210 were overpredicted at four and three sites, respectively. No constituents appear to be consistently understated. Total fluoride was slightly underpredicted at Site 1 and then only at the upper end of monitored data,

which is consistent with results presented in Sections 5.3.2 and 5.3.3. Total phosphorus was underpredicted at Site 3; however, further evaluation of Figure AI-2-134 indicates that this underprediction is slight.

At Site 7, cadmium, total chromium, and polonium-210 were significantly overpredicted, similar to the pattern observed in comparisons of mean daily and unpaired daily results presented in Sections 5.3.2 and 5.3.3.

These comparisons highlight the dramatic improvement in model performance obtained in the paired data set after the addition of background levels observed at Site 6. From a modeling perspective, this indicates that Site 6 is characteristic of background.

5.3.5 General Observations in Comparisons of Predicted and Observed Daily Constituent Levels

The ability of the daily emission inventories and dispersion model to predict daily constituent concentrations (or activities) was evaluated by a series of comparisons with observed data. Comparisons of the mean daily constituent levels were made with the mean levels calculated from the monitoring data collected at each of the seven monitoring sites. Comparisons of all daily predicted levels were made with all daily observed levels in a fashion unpaired in time but paired in space. Comparisons were also made between predicted and observed levels on days when the EMF facilities were consistently downwind from the background monitoring site. These comparisons were made to determine if the daily emission inventories were representative of typical facility emissions. Methods and criteria recommended in EPA guidelines were used in these evaluations of model performance.

Daily constituent levels are not appropriate for use in evaluating potential chronic risk. Rather, average annual predicted or observed constituent levels are appropriate for use in a risk assessment. (Refer to Section 5.2.3 for general observations concerning the predicted average annual constituent levels and their comparison with observed data.)

The predicted levels of 15 of the 18 constituents included in the daily emission inventories for which comparisons can be made with monitoring data were within the "factor of two" criteria used in EPA guidelines. Good agreement was observed between monitoring data and model predictions.

Total chromium emissions were found to be overstated in the emission inventories; this constituent was overpredicted at most monitoring sites in each of the model . Cadmium and polonium-210 were slightly overpredicted at various monitoring sites, and the emissions of these constituents may be slightly overstated in the inventories.

Cadmium, total chromium, and polonium-210 were consistently overpredicted at Site 7 (at factors between 2 and 9 times greater than observed levels). Site 7 is in elevated terrain. Analysis of the model and emission inventories indicate that the overpredictions are associated with constituents emitted predominantly from stacks. As discussed in the Section 5.4, these overpredictions result from well-known technical limitations of atmospheric dispersion models to perform in elevated terrain, rather than from a significant overstatement of the constituents' emission levels.

Also noted is that without the addition of background, a significant underprediction would occur for lead-210 at all sites. The addition of background to model predictions resulted in satisfactory agreements between both average annual modeled and average monitored activities, as well as in comparisons of daily predicted and observed activities.

As was discussed in the *Fall 1993 Data Interpretation Report* (Bechtel, 1994g), monitored levels of lead-210 over the EMF study area are typically observed at about the same activity level at all sites during any given monitoring day. Nriagu and Davidson (1986) attributed the presence of lead-210 in ambient air to the natural release of radon-222 from soils. Radon-222 has a short half-life (3.8 days). The longest half-life of its daughters, prior to the formation of lead-210, is 26.8 minutes, whereas the half-life of lead-210 is 21 years.

This process must also occur in the EMF study area, because radon is naturally present in the geologic materials within the study area. This is supported by the observations by DOE at the Rexburg, Idaho site (DOE, 1991), discussed in Part III, Volume 1 of the RI report, which show that the average annual activity of lead-210 is comparable to that observed in the EMF monitoring area.

5.4 ELEVATED TERRAIN EFFECTS

Several constituents (cadmium, chromium, and polonium-210) have been found to be consistently overpredicted by the atmospheric dispersion models at Site 7, the only monitoring site located on elevated terrain (4825 feet ASL and approximately 375 feet higher than the operating sources at the EMF facilities).

As discussed in Section 4.5.1, the II2 model can be run in a combined intermediate terrain mode, ISC2-only mode, or COMPLEX1-only mode. As stated in the modeling plan (Bechtel, 1992a), all results presented in this study utilized the combined intermediate terrain mode. However, to insure that the observed model overprediction at Site 7 was not due to the dominance of either the ISC2 or COMPLEX1 models (which both suffer from conservative assumptions of dispersion in complex terrain), a series of 24-hour maximum model-predicted results were calculated using first the ISC2-only mode and then the COMPLEX1-only mode. These results, when combined with FDM output, were compared with results presented in Section 5.3 of this report. These data show that, while some slight differences exist (ISC2 tends to provide higher results over COMPLEX1), these differences would not explain the model overprediction observed at Site 7 and correspondingly, at model receptors located on similar elevated terrain south of the facilities.

To further evaluate model behavior in elevated terrain, the annual average model results from the II2 model were compared with the average-annual constituent levels observed at Site 7. The purpose was to determine if the overprediction was attributable to the FDM receptor (located at ground level in FDM, which is a limitation of the model), rather than the II2 receptor at Site 7 (located some 375 feet higher than the FDM receptor).

The results indicate that if only the II2-predicted values were used (versus the combined II2 and FDM results) the average-annual values (reported in Section 5.2) would be only slightly lower for all analytes except TSP, arsenic, and thorium-230. These lower values would not result in a change in the classification of model performance for these constituents. This indicates that

model-predicted results for these constituents at Site 7 are dominated by stack-based sources (predicted by the II2 model) and not fugitive sources (from FDM). In the case of TSP and thorium-230, the II2-only predictions would meet model performance criteria (i.e., within a factor of two), rather than be overpredicted. For arsenic, the II2-only result would be an underprediction, rather than within a factor of two of the observed level.

Consequently, for constituents that were emitted predominantly from stacks, the model tends to overpredict plume impact on elevated terrain using the daily emission inventories. This conclusion is not surprising. It is well known within the atmospheric dispersion modeling community that stack emissions tend to be overpredicted at model receptors in elevated terrain. A review of the emission inventories indicates that the majority of cadmium, total chromium, and polonium-210 emissions are from stack sources rather than fugitive sources. Thus, it can be expected that overprediction of these constituents at Site 7 and at other model receptor locations in elevated terrain is due to conservative assumptions of dispersion inherent in the II2 modeling code, rather than an overstatement of constituent levels in the emission inventories.

Summary and Conclusions

EPA-specified atmospheric dispersion models were used to predict constituent levels in ambient air across the EMF site study area. These models used constituent emission rates that were typical of sources at the FMC, Simplot, and BAPCO facilities during the period between October 1, 1993 through September 30, 1994. These predictions were compared with data from a seven-station air quality monitoring network within the EMF site study area that was operated over this timeframe to judge the accuracy of the model. Model performance criteria and evaluation methods recommended by EPA were used in these comparisons.

These comparisons confirmed that the emission inventories adequately characterize emissions from these facilities. Predicted levels of site-related constituents match observed constituent levels (within the "factor of two" guideline established in EPA guidance) for 15 of 18 constituents, for which comparisons can be made. The remaining 3 were slightly overpredicted.

The highest annual average constituent concentrations (or activities in the case of radionuclides) of 17 constituents were predicted to occur at undeveloped and unoccupied land in the right-of-way between the facilities' industrial operations area and Highway 30. The remaining 4 were predicted to occur at similarly undeveloped and unoccupied land along the right-of-way of Interstate 86 north of the facilities. Land near these peak impact points is used for industrial or commercial purposes, but these predicted levels are between 100 to 1,000 times below levels that would be of concern in an industrial or commercial workplace. Beyond these points of maximum predicted effects, predicted elevated constituent levels generally coincide with land that is owned by either FMC or Simplot; there is no public access to these lands.

The following summary of the modeling study begins with a review of the emission inventories and dispersion modeling approach. This is followed by a summary of modeling results and comparisons of predicted and observed constituent levels.

Emission Inventories

The atmospheric dispersion modeling analysis began with an extensive revision of the 1992 SIP emission inventories of the EMF facilities prepared by EPA. The inventories were enhanced through the incorporation of new source characterizations for 20 major sources, expanded to include radionuclides, modernized to reflect current operating practices, and corrected through elimination of miscalculations and inappropriate assumptions. These inventories differ from typical SIP inventories because they describe typical constituent emission rates, rather than "potential to emit" rates. All known emission sources have been identified and characterized in the emission inventories. These inventories provide a better characterization of source emissions than the previous inventories and are more than sufficient to characterize the site.

Two types of inventories were prepared for the FMC, Simplot, and BAPCO facilities: one describing average annual emissions, and one describing typical daily emissions, for the period between October 1993 through September 1994. Constituents included in these inventories were: PM_{10}, TSP, antimony, arsenic, beryllium, cadmium, total chromium, total fluoride, lead, nickel, total phosphorus, total silica, lead-210, polonium-210, radium-226 and -228, thorium-230 and -232, and uranium-234, -235, and -238. One hundred-nineteen sources are included in the inventories; these include point, area, and line-type emission sources.

Initial predictions of average annual constituent concentrations (or activities) using these enhanced inventories were reported to EPA in a September 1994 modeling study (Bechtel, 1994k). Further refinement of these inventories occurred between the publication of the September 1994 modeling study and this report.

EMF facility emissions from active operations can be classified in three categories.

1. Fugitive emissions from material handling activities.
2. Point source emissions from process stacks.
3. Fugitive emissions from processes characterized as area sources.

A summary of annual constituent emissions from point, area, and line sources at FMC, Simplot, and BAPCO are provided in Tables 6-1 through 6-3, respectively.

Modeling Objectives and Approach

The objective of the modeling study was to characterize the effect of emissions from FMC, Simplot, and BAPCO sources on ambient air quality coincident with the period of operation of the seven-station EMF air monitoring network. The modeling results presented in this study have been made using one-year of site-specific meteorological data collected at Site 1 as part of this monitoring program. The average annual and typical daily constituent concentrations (or activities) in ambient air were predicted with EPA-specified models (InterISC2 and FDM).

Predicted Average Annual Constituent Levels

The predicted average annual constituent concentrations (or activities) were plotted as lines of equal concentration (or equal activity) — referred to as isopleths — across the domain of 212 model receptor points within the EMF site study area. These predictions were also compared with statistical data from the seven-site EMF air monitoring network for samples collected within this same period to evaluate model performance. Methods and criteria presented in EPA guidelines (Cox, 1988) were used in evaluating model performance, as recommended by EPA, Region 10 personnel. These guidelines indicate that model predictions are accurate when they agree with observed data within a factor of two.

Background levels were added to model predictions as part of the process of evaluating the accuracy of model predictions. Constituents detected in monitoring samples collected at Site 6 when this site was upwind from the EMF facilities were used to characterize background air quality. Constituents present in background include: particulate matter (PM_{10} and TSP); metals (including arsenic, total chromium, nickel); total fluorides; crystalline silica; and radionuclides (including uranium isotopes, lead-210, and polonium-210). Site 6 is in a rural setting with little development, and may understate background levels that might be found in more developed areas in Pocatello.

Table 6-1
Summary of FMC Emissions

	PM_{10}		TSP		Antimony		Arsenic		Beryllium	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	1,654.38	190.99	2,725.03	321.49	0.10	8.95E-03	1.10E-01	9.36E-03	8.83E-04	1.23E-04
Point Fugitives:	504.76	78.62	1,286.53	203.60	1.75E-02	1.96E-03	3.69E-02	5.80E-03	1.16E-04	1.79E-05
Area Sources:	366.58	67.80	979.06	180.64	0.15	2.69E-02	5.82E-03	1.02E-03	1.06E-04	1.92E-05
Roads:	360.17	41.17	597.78	62.95	0.00	0.00	8.89E-03	9.86E-04	1.17E-04	1.34E-05
Stockpiles:	642.93	87.82	1,456.16	206.47	1.62E-05	1.12E-05	2.66E-02	3.49E-03	2.09E-04	2.86E-05
Total Plant:	3,528.83	466.39	7,044.56	975.15	0.26	3.78E-02	1.88E-01	2.07E-02	1.43E-03	2.02E-04

	Cadmium		Total Chromium		Fluoride		Lead		Nickel	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	2.05	0.19	1.52	2.22E-01	93.23	12.20	0.19	2.05E-02	0.33	4.71E-02
Point Fugitives:	0.15	1.88E-02	0.90	1.34E-01	41.53	5.99	3.44E-02	4.05E-03	0.17	2.52E-02
Area Sources:	5.22E-02	9.43E-03	0.21	3.48E-02	19.77	3.63	2.36E-02	4.29E-03	0.06	1.01E-02
Roads:	5.67E-02	6.63E-03	0.24	2.71E-02	12.44	1.31	2.43E-02	2.75E-03	0.05	5.16E-03
Stockpiles:	0.15	2.04E-02	1.48	0.19	26.36	3.63	0.03	4.10E-03	0.26	3.44E-02
Total Plant:	2.45	0.25	4.34	0.61	193.33	26.76	0.30	3.57E-02	0.87	0.12

	Total Phosphorus		Total Silica		Pb-210		Po-210		Ra-226	
	lb/day	tons/yr	lb/day	tons/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	158.06	16.42	93.30	14.71	1.01E-05	2.87E-03	1.57E-02	4.29	1.37E-05	3.87E-03
Point Fugitives:	66.91	11.16	60.66	9.65	3.83E-06	1.08E-03	4.39E-06	1.43E-03	3.72E-06	1.15E-03
Area Sources:	9.95	1.75	13.95	2.39	8.11E-06	2.96E-03	4.70E-06	1.66E-03	1.55E-06	5.43E-04
Roads:	5.02	0.58	60.50	6.88	ND	ND	ND	ND	ND	ND
Stockpiles:	36.94	4.73	112.77	15.65	9.49E-06	3.03E-03	1.80E-05	5.18E-03	7.13E-06	1.94E-03
Total Plant:	276.89	34.64	341.18	49.28	3.16E-05	9.93E-03	1.57E-02	4.30	2.60E-05	7.50E-03

	Ra-228		Th-230		Th-232		U-234		U-235		U-238	
	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	5.46E-07	1.56E-04	1.21E-05	3.44E-03	3.84E-07	1.12E-04	1.25E-05	3.54E-03	5.36E-07	1.53E-04	1.26E-05	3.55E-03
Point Fugitives:	1.57E-07	4.74E-05	3.15E-06	9.68E-04	1.58E-07	4.77E-05	3.35E-06	1.02E-03	1.45E-07	4.44E-05	3.16E-06	9.64E-04
Area Sources:	2.09E-07	7.56E-05	1.08E-06	3.78E-04	2.10E-07	7.62E-05	1.12E-06	3.93E-04	4.92E-08	1.73E-05	1.06E-06	3.72E-04
Roads:	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Stockpiles:	4.17E-07	1.30E-04	5.41E-06	1.44E-03	4.20E-07	1.30E-04	5.14E-06	1.36E-03	2.25E-07	5.96E-05	4.86E-06	1.29E-03
Total Plant:	1.33E-06	4.09E-04	2.18E-05	6.23E-03	1.17E-06	3.67E-04	2.21E-05	6.31E-03	9.56E-07	2.74E-04	2.16E-05	6.17E-03

ND - No data for estimating.

Table 6-2
Summary of JRS Emissions

	PM_{10}		TSP		Antimony		Arsenic		Beryllium	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	816.10	130.84	1,439.50	234.78	9.99E-04	1.82E-04	1.06E-02	1.93E-03	0.00	0.00
Point Fugitives:	80.23	11.25	97.83	13.72	0.00	0.00	0.00	0.00	0.00	0.00
Area Sources:	30.24	4.14	201.60	27.61	0.00	0.00	0.00	0.00	0.00	0.00
Roads:	65.25	3.34	80.09	3.81	2.42E-04	1.12E-05	1.42E-03	6.55E-05	0.00	0.00
Stockpiles:	110.96	7.90	232.50	16.38	8.83E-04	6.22E-05	1.67E-04	1.18E-05	5.35E-05	3.77E-06
Total Plant:	1,102.78	157.47	2,051.51	296.30	2.12E-03	2.56E-04	1.22E-02	2.01E-03	5.35E-05	3.77E-06

	Cadmium		Total Chromium		Fluoride		Lead		Nickel	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	6.57E-02	1.17E-02	6.32E-01	1.15E-01	934.80	151.98	9.40E-03	1.72E-03	1.55E-01	2.77E-02
Point Fugitives:	1.29E-02	1.88E-03	2.07E-03	2.70E-04	13.85	1.50	0.00	0.00	1.93E-03	2.45E-04
Area Sources:	2.40E-03	3.38E-04	9.07E-04	1.18E-04	3.10	0.40	0.00	0.00	9.84E-04	1.23E-04
Roads:	8.32E-03	3.83E-04	8.20E-02	3.98E-03	ND	ND	3.12E-03	1.66E-04	1.79E-02	8.84E-04
Stockpiles:	8.09E-03	5.70E-04	2.56E-02	1.80E-03	7.68	1.21	1.26E-03	8.84E-05	5.93E-03	4.18E-04
Total Plant:	0.10	1.48E-02	0.74	0.12	959.43	155.09	1.38E-02	1.97E-03	0.18	2.94E-02

	Total Phosphorus		Total Silica		Pb-210		Po-210		Ra-226	
	lb/day	tons/yr	lb/day	tons/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	48.50	7.85	11.02	2.01	1.68E-06	5.85E-04	7.32E-06	2.56E-03	8.70E-06	3.03E-03
Point Fugitives:	3.41	0.47	0.00	0.00	4.43E-08	1.15E-05	2.00E-07	5.32E-05	8.29E-08	2.01E-05
Area Sources:	1.08	0.14	0.00	0.00	2.57E-08	6.51E-06	8.91E-08	2.12E-05	5.69E-08	1.29E-05
Roads:	4.16	0.20	6.42	0.34	ND	ND	ND	ND	ND	ND
Stockpiles:	1.53	0.11	ND	ND	5.54E-08	7.88E-06	1.31E-06	1.86E-04	1.16E-06	1.65E-04
Total Plant:	58.67	8.77	17.44	2.35	1.81E-06	6.11E-04	8.92E-06	2.82E-03	9.99E-06	3.23E-03

	Ra-228		Th-230		Th-232		U-234		U-235		U-238	
	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	5.05E-08	1.32E-05	1.35E-05	4.51E-03	1.34E-07	4.38E-05	1.08E-05	3.68E-03	2.21E-07	7.83E-05	8.13E-06	2.66E-03
Point Fugitives:	1.41E-08	3.68E-06	1.78E-06	5.08E-04	4.85E-08	1.43E-05	3.41E-07	8.16E-05	5.95E-09	1.55E-06	9.91E-07	2.74E-04
Area Sources:	6.17E-09	1.61E-06	4.36E-07	1.13E-04	7.13E-09	2.10E-06	2.34E-07	5.44E-05	2.61E-09	6.80E-07	3.26E-07	8.19E-05
Roads:	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Stockpiles:	0.00	0.00	1.31E-06	1.86E-04	0.00	0.00	1.21E-06	1.72E-04	0.00	0.00	0.00	0.00
Total Plant:	7.07E-08	1.85E-05	1.70E-05	5.32E-03	1.90E-07	6.03E-05	1.25E-05	3.99E-03	2.30E-07	8.05E-05	9.44E-06	3.01E-03

ND - No data for estimating.

Table 6-3
Summary of BAPCO Emissions

	PM_{10}		TSP		Antimony		Arsenic		Beryllium	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	10.85	0.56	13.45	0.67	0.00	0.00	1.11E-05	2.03E-07	4.51E-07	8.25E-09
Point Fugitives:	66.08	3.53	198.32	10.75	0.00	0.00	3.70E-05	6.66E-07	1.51E-06	2.71E-08
Area Sources:	1,054.32	44.49	2,287.32	97.67	2.35E-01	1.38E-02	3.89E-02	2.33E-03	1.65E-04	1.17E-05
Roads:	153.96	13.04	304.98	25.06	0.00	0.00	0.00	0.00	5.00E-05	4.23E-06
Stockpiles:	59.06	4.96	123.74	10.31	2.31E-02	1.94E-03	3.90E-03	3.27E-04	1.90E-05	1.59E-06
Total Plant:	1,344.28	66.58	2,927.81	144.46	2.58E-01	1.57E-02	4.29E-02	2.66E-03	2.36E-04	1.76E-05

	Cadmium		Total Chromium		Fluoride		Lead		Nickel	
	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr	lb/day	tons/yr
Point Sources:	0.00	0.00	3.04E-04	5.56E-06	ND	ND	2.84E-05	5.19E-07	1.57E-04	2.88E-06
Point Fugitives:	0.00	0.00	1.02E-03	1.83E-05	ND	ND	9.49E-05	1.71E-06	5.25E-04	9.44E-06
Area Sources:	3.19E-01	1.87E-02	3.54E-01	2.21E-02	19.06	1.12	6.84E-02	4.14E-03	6.64E-02	4.61E-03
Roads:	5.44E-03	5.71E-04	1.15E-01	9.40E-03	6.35	0.52	2.73E-03	2.87E-04	1.92E-02	1.59E-03
Stockpiles:	3.14E-02	2.63E-03	3.67E-02	3.07E-03	1.80	0.15	6.90E-03	5.78E-04	7.52E-03	6.28E-04
Total Plant:	3.56E-01	2.19E-02	5.06E-01	3.46E-02	27.20	1.79	7.82E-02	5.01E-03	9.38E-02	6.84E-03

	Total Phosphorus		Total Silica		Pb-210		Po-210		Ra-226	
	lb/day	tons/yr	lb/day	tons/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	1.77E-03	3.23E-05	2.47E-02	4.52E-04	1.17E-09	4.29E-08	6.35E-10	2.32E-08	3.91E-10	1.43E-08
Point Fugitives:	5.90E-03	1.06E-04	8.26E-02	1.49E-03	3.92E-09	1.41E-07	2.12E-09	7.63E-08	1.31E-09	4.69E-08
Area Sources:	8.85	0.53	86.93	5.21	1.76E-05	2.23E-03	1.34E-05	1.58E-03	4.23E-06	4.96E-04
Roads:	1.89	0.16	26.55	2.26	6.04E-06	1.02E-03	4.95E-06	8.39E-04	1.56E-06	2.64E-04
Stockpiles:	0.88	0.07	8.70	0.73	1.62E-06	2.73E-04	1.33E-06	2.23E-04	4.20E-07	7.05E-05
Total Plant:	11.64	0.76	122.28	8.21	2.52E-05	3.52E-03	1.97E-05	2.64E-03	6.21E-06	8.30E-04

	Ra-228		Th-230		Th-232		U-234		U-235		U-238	
	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr	Ci/day	Ci/yr
Point Sources:	0.00	0.00	9.77E-11	3.57E-09	0.00	0.00	1.13E-09	4.15E-08	4.96E-11	1.81E-09	1.07E-09	3.91E-08
Point Fugitives:	0.00	0.00	3.26E-10	1.17E-08	0.00	0.00	3.79E-09	1.36E-07	1.66E-10	5.96E-09	3.57E-09	1.28E-07
Area Sources:	6.92E-07	8.12E-05	2.58E-06	3.03E-04	6.92E-07	8.12E-05	2.63E-06	3.19E-04	1.15E-07	1.40E-05	2.48E-06	3.01E-04
Roads:	2.55E-07	4.32E-05	4.13E-08	6.99E-06	2.55E-07	4.32E-05	9.43E-07	1.60E-04	4.13E-08	6.99E-06	8.89E-07	1.51E-04
Stockpiles:	6.80E-08	1.14E-05	2.55E-07	4.28E-05	6.80E-08	1.14E-05	2.66E-07	4.46E-05	1.16E-08	1.95E-06	2.51E-07	4.20E-05
Total Plant:	1.01E-06	1.36E-04	2.88E-06	3.53E-04	1.01E-06	1.36E-04	3.85E-06	5.24E-04	1.68E-07	2.29E-05	3.63E-06	4.94E-04

ND = No data available

Background sources contribute a significant portion of observed concentrations of constituents detected in the ambient air quality monitoring program. One example is lead-210. Naturally-occurring radon-222 decays to lead-210, which was observed on many days during the ambient monitoring data at nearly equivalent activities in samples collected both up-and down-wind from the EMF facilities. Arsenic is a site-related constituent but was also present at significant levels in background, where it may have been introduced to the local air shed through long-range transport from distant sources. Particulate levels (PM_{10} and TSP) increased seasonally in association with agricultural activities.

Five general observations were noted in the analysis of the predicted average annual constituent concentrations (or activities) and isopleth maps:

1. The isopleths exhibit, to varying degrees, a pattern similar to the shape of butterfly wings, with decreasing concentrations (or activities) spreading outwards from the common northern boundary of the industrial operations area of the FMC and Simplot plants. This pattern is typically elongated along the northwest axis, particularly for constituents that were emitted predominantly from point sources (i.e., cadmium, polonium-210, total fluorides). Figure 6-1 displays these patterns in the isopleths for PM_{10} concentrations.
2. The highest predicted average annual concentrations (or activities) for PM_{10}, TSP, total fluorides, metals, and radionuclides occurred in an area north of the facilities, either between the fenceline of the industrial operations area and Highway 30 or along the right-of-way of Interstate 86 north of BAPCO. These points of maximum modeled impact — as well as much of the area of elevated levels — occurred at undeveloped and unoccupied land. The highest predicted average annual constituent concentration (or activity) occurred at one of four model grid positions within this area, depending upon the specific constituent.
3. The highest predicted average annual constituent concentrations (or activities) were between 100 and 1,000 times below concentrations (or activities) that would be of concern in an industrial or commercial workplace.

4. The accuracy of the model predictions meets EPA criteria for 15 of the 18 constituents for which model predictions can be compared with monitoring data. The highest average annual, as well as the average annual predicted levels of PM_{10}, TSP, total fluorides, arsenic, cadmium, lead-210, and polonium-210 (after addition of background levels) were within a factor of two of observed levels. The highest predicted average annual activities of uranium-234, -235, and -238 were within a factor of two of observed levels. but the average levels of these radionuclides tended to be overpredicted at several of the monitoring sites. The average annual model predicted concentrations (or activities) of beryllium, radium-226 and -228, and thorium-232 were below detection levels, which is consistent with monitoring observations.

5. The highest average annual concentrations of total chromium and nickel, and activity of thorium-230 were overpredicted. The overpredictions may be attributable to an overstatement of emissions of these constituents. The average annual concentration of total phosphorus was slightly underpredicted at several sites, although the highest predicted concentration was within a factor of two of the highest average annual concentration determined in the monitoring program.

Table 6-4 lists the predicted average annual constituent concentration (or activities) at each monitoring station. It also lists model predictions to which average background levels have been added and compares these with the average annual levels observed in the monitoring program. Predictions that meet EPA performance guidelines are identified as being within a factor of two of observed levels.

Additional Evaluations of Model Perfomance

Predictions of daily constituent concentrations (or activities) in ambient air were compared with data collected from the seven-site EMF air monitoring as an additional means of evaluating model performance. Four types of comparisons were made using techniques and criteria recommended by EPA. The first was a comparison of predicted and observed mean daily levels. The second was a comparison of all predicted and observed levels in a manner unpaired in time. Comparisons were also made between daily predicted and observed levels on days when the facilities were predominantly downwind of the background monitoring site.

Table 6-4
Comparison of Model Predictions with Monitoring Results

Constituent	Highest-Annual Average Modeled Concentration‡ ($\mu g/m^3$)	Highest-Averaged Monitored Concentration* ($\mu g/m^3$)	Highest-Annual Average Modeled Concentration with Background ($\mu g/m^3$)	Model (with background) to Monitoring Comparison
PM_{10} †	40.08	56.5	55	within 2
TSP	74.13	137.1	116	within 2
Antimony ‡	4.79E-03	NA	NA	NA
Arsenic ‡	1.82E-03	1.27E-03	2.33E-03	within 2
Beryllium ‡	1.06E-05	1.79E-04	1.06E-05	agrees†
Cadmium ‡	7.75E-03	1.16E-02	7.75E-03	within 2
Total Chromium ‡	5.75E-02	1.74E-02	5.77E-02	> 2
Total Fluoride ‡	3.34	3.7	4.9	within 2
Lead †	2.31E-03	NA	NA	NA
Nickel ‡	1.08E-02	4.85E-03	1.08E-02	> 2
Total Phosphorus ‡	3.04	5.5	3.0	within 2
Total Silica ‡	4.5	NA	NA	NA
Constituent	**Highest-Annual Average Modeled Activity (pCi/m^3)**	**Highest-Averaged Monitored Activity (pCi/m^3)**	**Highest-Annual Average Monitored Activity with Background (pCi/m^3)**	**Model (with background) to Monitoring Comparison**
Lead-210	1.23E-03	2.45E-02	1.82E-02	within 2
Polonium-210	1.05E-01	6.92E-02	1.09E-01	within 2
Radium-226	4.63E-04	**	4.63E-04	within 2†
Radium-228	4.73E-05	**	4.73E-05	within 2†
Thorium-230	6.54E-04	2.85E-04	6.54E-04	> 2
Thorium-232	4.73E-05	**	4.73E-05	agrees†
Uranium-234	3.78E-04	4.04E-04	4.03E-04	within 2
Uranium-235	1.60E-05	1.85E-05	1.64E-05	within 2
Uranium-238	4.70E-04	3.80E-04	4.79E-04	within 2

Footnotes:

NA - Not analyzed.

Within 2 = Model predictions are within a factor of 2 of the highest-averaged monitored level.

> 2 = Highest average annual modeled level is greater than twice the highest average annual monitored level.

< 2 = Highest average annual modeled level is less than one-half the highest average annual monitored level.

* Highest-averaged monitored values are those that were observed among the averaging of data from monitoring Sites 1 through 7. Averaging times for monitored data are functionally equivalent to annual averages although the PM10 and TSP are averaged over 13 months of data and the remainder of the constituents are averaged over only 6 months.

** Two or less detected values.

† Model prediction was compared with the IDL. Both model and monitoring agree that constituents are below detection levels.

‡ Highest-modeled values are those that occurred anywhere over the modeled area. The location of the modeled points may be found on Table 5.2.1-1.

The fourth type of comparison used case study analyses of facility emissions on five days (October 24, 1993; January 6, 1994; January 20, 1994; April 14, 1994; and June 7, 1994) to evaluate model performance. These case studies had several objectives. The first was to determine if the typical daily emission inventories were representative of facility emissions on days when the highest levels of key site-related constituents were observed in the monitoring program. Another was to determine if the model would successfully predict constituent levels during unusual conditions and during a period of reduced facility operations. One case study (January 20, 1994) was performed to evaluate facility emissions during a minor atmospheric stagnation episode, as requested by IDEQ.

The predicted levels of 15 of the 18 constituents in the daily emission inventories for which comparisons could be made with monitoring data, were within the "factor of two" criteria used in EPA guidelines to define acceptable model performance. Of the remaining three, total chromium emissions were found to be overstated in the emission inventories. This constituent was overpredicted at most monitoring sites in each of the model . Cadmium and polonium-210 were slightly overpredicted at various monitoring sites, and the emissions of these constituents may be slightly overstated in the inventories.

Cadmium, total chromium, and polonium-210 were consistently overpredicted at Site 7 (at factors between 2 and 9 times greater than observed). Site 7 is located in elevated terrain. These overpredictions result from well-known technical limitations of atmospheric dispersion models to perform in elevated terrain, rather than from a significant overstatement of the constituents' emission levels.

The evaluation of site emissions during the January 1994 atmospheric stagnation episode demonstrated that site emissions had little, if any, impact in the residential area north of I-86 (in the vicinity of monitoring Sites 3 and 4). The observed levels of site-related constituents (e.g., cadmium, total phosphorus, uranium-238) were either not detected in monitoring samples or were observed near their detection levels. The model predicted similar levels. However, the

observed concentrations of PM_{10} were much greater than the very low PM_{10} concentrations predicted by the model for these sites. This indicates that the observed PM_{10} levels were attributable to other emission sources within the Pocatello area and not to modeled emissions from the EMF facilities.

Conclusions

Air monitoring and modeling data indicate that measurable effects of the EMF facilities on ambient air quality are limited to a few specific constituents. The predicted area of greatest effect on ambient air quality from these emissions occurred at undeveloped and unoccupied land along two highway right-of-ways. Beyond these points of maximum predicted effects, predicted elevated constituent levels generally coincided with land that is owned by either FMC or Simplot. There is no public access to these lands, and consequently, there is little potential for public exposure.

The combined effect of the revised inventories, the use of high-quality meteorological data, and the evaluation of model performance using comparisons with site-specific air quality monitoring data have established a sound understanding of the fate and transport mechanisms of site-related constituents. The resulting model provides the means to reliably predict the levels of site-related constituents in air across the EMF site study area.